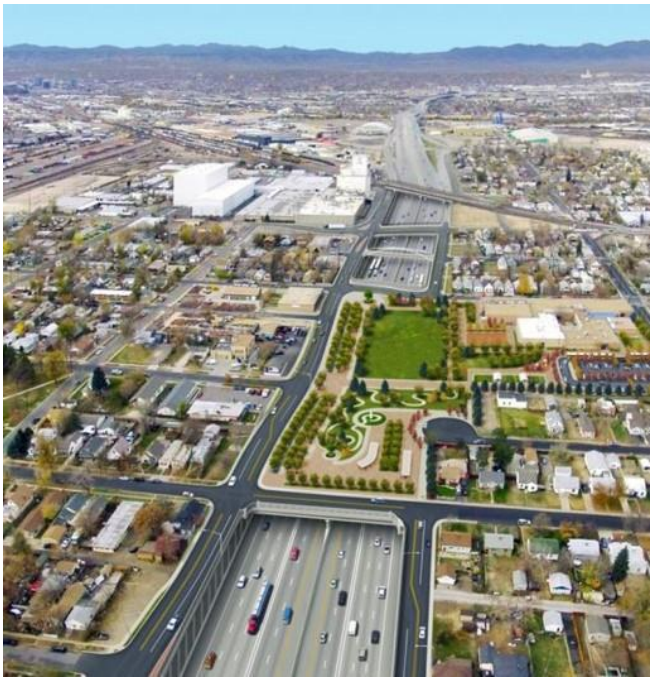
Project Agreement
for the I-70 East Project



COLORADO BRIDGE ENTERPRISE,
HIGH PERFORMANCE TRANSPORTATION ENTERPRISE,
and
[*DEVELOPER*]

Dated [ ]

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This Project Agreement (this "Agreement") is dated as of [ ] (the "Agreement Date") and made among:

(1) Colorado High Performance Transportation Enterprise ("HPTE"), a government-owned business within and a division of the Colorado Department of Transportation ("CDOT");

(2) Colorado Bridge Enterprise, a government-owned business within CDOT ("BE" and, together with HPTE, each individually an "Enterprise" and, together, the "Enterprises"); and

(3) [ ], a [*describe type of legal entity and reference state of incorporation/organization*] ("Developer").

RECITALS

Whereas:

(A) CDOT has determined that the deteriorating condition and inadequate capacity of the I-70 East corridor requires a comprehensive transportation solution to resolve such challenges and to address other stakeholder and community concerns.

(B) Based on a review process conducted in accordance with the National Environmental Policy Act of 1969 ("NEPA"), CDOT identified a preferred alternative, the Preferred Alternative (as defined in Part A of Annex A (*Definitions and Abbreviations*)) to address these challenges and concerns.

(C) HPTE was created to pursue innovative means of more efficiently financing important surface transportation projects to improve the safety, capacity, and accessibility of the surface transportation system in the State, which means include public-private partnerships, user fee-based project financing, and availability payment and design-build contracting.

(D) BE was created for the purpose of financing, repairing, reconstructing, and replacing designated bridges that have been identified by CDOT as being structurally deficient or functionally obsolete.

(E) Pursuant to the State's Funding Advancements for Surface Transportation and Economic Recovery legislation, C.R.S. §§ 43-1-801, *et seq.*, the Enterprises were created as government-owned businesses within CDOT, each with certain limited statutory powers and duties necessary to accomplish their respective business purposes.

(F) Pursuant to Resolution #TC-15-2-5 approved February 19, 2015 by the State's Transportation Commission (the "Transportation Commission"), the Transportation Commission delegated to the Enterprises the responsibility for procurement of the design, construction, financing, operation and maintenance of a portion of the I-70 East corridor in Greater Denver (such portion, the "Project"), the scope of which Project is reflected by the scope of the Work required to be performed by Developer pursuant to the terms of this Agreement.

(G) The design, construction, financing, operation and maintenance method of procurement for the Project is intended to reduce overall Project cost and maximize the improvements that can be constructed, in part, by requiring private parties to assume and manage certain risks associated with the Project, including risks related to utilities, railroads, environmental conditions, and financial and market conditions.

(H) On March 25, 2015, the Enterprises issued a Request for Qualifications for the Project, as subsequently amended on May 29, 2015.

(I) On June 22, 2015, the Enterprises received five responsive statement of qualification submittals from potential project developer groups, and then shortlisted four such groups on July 24, 2015 (each a "Proposer" and, collectively, the "Proposers") for purposes of proceeding to the next stage in the procurement process for the Project.

(J) Subsequently, the Enterprises issued a draft Request for Proposals ("RFP"), which included the Instructions to Proposers ("ITP"), first issued on September 15, 2015, and a draft of this Agreement, first issued on September 29, 2015. On [ ], 2016 the Enterprises issued the final RFP.

(K) On [ ], the Federal Highway Administration (the "FHWA") issued the Final Environmental Impact Statement ("FEIS"), and on [ ] the FHWA issued the Record of Decision for the Preferred Alternative (as defined in Part A of Annex A (*Definitions and Abbreviations*)) (the "ROD"), in each case pursuant to NEPA. The Project reflects the first phase of the Preferred Alternative.

(L) On [ ], the Enterprises received the Proposers' proposals in response to the RFP.

(M) On [ ], the Enterprises issued a notice identifying the successful Proposer (the "Preferred Proposer") to which the Project was awarded, subject to satisfaction of certain conditions precedent under the ITP to execution of this Agreement by Developer to be formed by the Equity Members (as defined in Part A of Annex A (*Definitions and Abbreviations*)) of such Preferred Proposer.

(N) As of the Agreement Date, the Equity Members of the Preferred Proposer have formed Developer to execute this Agreement with the Enterprises, and have otherwise satisfied the conditions precedent under the ITP to execution of this Agreement.

(O) This Agreement and the further agreements referred to herein set out or, as applicable, will set out, the terms and conditions pursuant to which Developer will implement the Project and perform the Work in consideration for the payments to be made by the Enterprises to Developer under this Agreement

Now, therefore, in consideration of their mutual undertakings and agreements hereunder, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties undertake and agree as follows:

PART A: DEFINITIONS AND ABBREVIATIONS; INTERPRETATION; PROJECT INFORMATION

1. DEFINITIONS AND ABBREVIATIONS

Except as otherwise specified herein or as the context may otherwise require:

a. terms set out in Part A of Annex A (*Definitions and Abbreviations*) have the respective meanings set out therein for all purposes of this Agreement;

b. terms defined in either the CDOT Standard Specification for Road and Bridge Construction or the CDOT Standard Special Provisions, each as modified for purposes of this Agreement pursuant to Appendix A to Schedule 10A (*Applicable Standards and Specifications*), have the respective meanings set out therein for purposes of the Technical Requirements only; and

c. abbreviations set out in Part B of Annex A (*Definitions and Abbreviations*) are provided as references for purposes of the Technical Requirements, Table 6A.1 and Table 6A.2 only.

2. INTERPRETATION OF THIS AGREEMENT

2.1. Interpretation of Certain Terms, Phrases and Language

2.1.1. Headings and other internal references

a. Headings are inserted for convenience only and shall not affect interpretation of this Agreement.

b. Except as the context may otherwise provide, the words "herein", "hereof" and "hereunder", and words of similar import, shall be construed to refer to this Agreement in its entirety and not to any particular provision of it.

c. Except as otherwise expressly provided or as the context may otherwise provide, a reference to any Section within this Agreement (including Annex A (*Definitions and Abbreviations*) and the Schedules) is a reference to such Section of this Agreement (excluding the Schedules).

2.1.2. Common terms and references

a. The singular includes the plural and vice versa.

b. Words preceding "include", "includes", "including" and "included" shall be construed without limitation by the words that follow.

c. The verb "will" has the same meaning and effect as the verb "shall."

d. The word "promptly" means as soon as reasonably practicable in light of then-prevailing circumstances.

2.1.3. References to agreements, documents, Laws, Governmental Approvals and Permits

Except as otherwise expressly provided in this Agreement, a reference:

a. to an agreement or other document shall be construed to be a reference to such agreement or other document (including any schedules, annexes or exhibits thereto) as it may be amended, modified or supplemented from time to time pursuant to its terms; and

b. to any Law (other than in the definition of Change in Law), Governmental Approval or Permit shall be construed as a reference to such Law, Governmental Approval or Permit as amended, replaced, consolidated or re-enacted (as applicable) from time to time.

2.1.4. References to Persons

Except as otherwise expressly provided in this Agreement:

a. a reference to a Person includes such Person's permitted successors, assigns and transferees;

b. the feminine includes the masculine and vice-versa; and

c. the words "they", "them", "themselves" and "their" when used to refer to a single Person or a grammatically singular antecedent shall be construed to mean an individual of unknown gender or whose gender is irrelevant.

2.1.5. Professional language and terms of art

Except as otherwise expressly provided in this Agreement:

a. words and phrases not otherwise defined herein:

i. that have well-known technical or construction industry meanings shall be construed pursuant to such recognized meanings; and

ii. of an accounting or financial nature shall be construed pursuant to GAAP,

in each case taking into account the context in which such words and phrases are used;

b. all statements of, or references to, dollar amounts or money, including references to "$" and "dollars", are to the lawful currency of the United States of America; and

c. all references to "digital" or "electronic" media or communications shall include all technology or services having electrical, digital, magnetic, wireless, optical, electromagnetic or similar capabilities that are used to facilitate the storage or dissemination of data and information as of the Setting Date, and all other successor forms of technology that serve the same or equivalent purposes which come into existence or widespread use after the Setting Date.

2.1.6. Deadlines occurring on Calendar Days

Whenever this Agreement requires the Enterprises (or CDOT acting as their designee pursuant to Section 18.1.2.a) to make any payment, or provide or deliver any Acceptance, Approval, consent, approval or like assent, notice, comment or any information or material, or otherwise complete any action or performance, in each case on or no later than a date that is a Calendar Day but not

a Working Day, then such deadline shall automatically be extended to the next Working Day to occur after such Calendar Day.

2.2. Terminology for Agreements and Assents

2.2.1. Agreements and determinations

Where this Agreement provides that a matter shall be "agreed or determined", such reference shall mean either that:

a. the Parties have agreed to the matter in writing; or

b. that the matter has been determined pursuant to the Dispute Resolution Procedures.

2.2.2. Consents, approvals and like assents

Except as otherwise expressly provided in this Agreement, where this Agreement provides that any consent, approval or like assent:

a. shall not be "unreasonably withheld" by a Person, then it shall not be unreasonably withheld, delayed or made subject to the imposition of unreasonable conditions by such Person; and

b. is to be made or given in the "discretion" of a Person, it shall be made or given only in the sole and absolute discretion of such Person (which discretion includes the ability to refrain from giving, or to impose conditions on, such consent, approval or like assent), which discretionary decision regarding any consent, approval or like assent shall be final and binding and not subject to the Dispute Resolution Procedures other than with respect to:

   i. a good faith dispute concerning whether the consent, approval or like assent was discretionary; or

   ii. a breach of the implied covenant of good faith and fair dealing.

2.2.3. Acceptance, Approval and Information

Where this Agreement provides that any matter or information shall be submitted to the Enterprises (or to CDOT acting as their designee pursuant to Section 18.1.2.a) for their:

a. "Acceptance", then the Enterprises shall give their determination in writing and may not unreasonably withhold their Acceptance, after having a reasonably sufficient opportunity to review and comment on such submission, where the only bases for withholding such Acceptance shall be if the Enterprises determine, acting reasonably, that the subject-matter of such submission:

   i. does not, or is unlikely to, comply with this Agreement;

   ii. does not, or is unlikely to, comply with Law;

   iii. is not made pursuant to, or otherwise is not or likely would not be, compliant with, Good Industry Practice; or

   iv. could give rise to a material risk to the health or safety of any person, the Environment, the community or property,

(where any failure to respond within a time period expressly provided in this Agreement shall be deemed an Acceptance of such submission by the Enterprises);

b. "Approval", then the Enterprises shall give their determination in writing and may reject such submission in their discretion (where any failure to respond within a time period expressly provided in this Agreement shall be deemed a rejection of such submission by the Enterprises); and

c. "Information", then no Acceptance, Approval, or other consent, approval or like assent, is required and the matter or information is being submitted for the Enterprises' information, review and comment only.

2.2.4. Default standards for consents, approvals and like assents

Where this Agreement requires one Party (including CDOT acting as the Enterprises' designee pursuant to Section 18.1.2.a) to provide a consent, approval or like assent to the other Party (excluding any waiver (for which purposes Section 43.3 shall apply) and any matter or submission expressly requiring Acceptance or Approval) and no express standard for such consent, approval or like assent is given, then such consent, approval or like assent shall be in writing and:

a. with respect to Developer, not be unreasonably withheld; and

b. with respect to the Enterprises, be in their discretion.

2.2.5. Limited Developer reliance

a. Developer may rely on Acceptances and Approvals, any other consent, approval or like assent, and any notice, from the Enterprises (including from CDOT acting as their designee pursuant to Section 18.1.2.a) only for the limited purpose of establishing that the Acceptance or Approval, or any other consent, approval or like assent, occurred, or any notice was given.

b. Except as otherwise expressly provided in this Agreement, no:

i. Acceptance or Approval, other consent, approval or like assent, or notice;

ii. comment, review, certification, concurrence, verification or oversight; or

iii. payment,

or the absence of any of the foregoing, shall in any case:

iv. constitute acceptance of materials, Work or any Element as satisfying the requirements of this Agreement;

v. relieve Developer from, or diminish Developer's liability for, the performance of its obligations under this Agreement;

vi. prevent the Enterprises from subsequently exercising their rights under this Agreement without being bound by the manner in which they or it previously exercised (or refrained from exercising) such rights; or

vii. constitute a waiver of any rights under this Agreement of any legal or equitable right of the Enterprises or of any other Person.

2.3. Indexation of Amounts

Where in this Agreement an amount is expressed to be "indexed", such expression means that the relevant amount will be changed on the first Calendar Day of each Contract Year (the "Relevant Contract Year") by applying the following formula:

$$V_{new} = V_{old} \times \frac{(1 + (I_{new} - I_{old}))}{I_{old}}$$

Where:

a. V_{new} is the new amount for the Relevant Contract Year;

b. V_{old} is the amount for the Contract Year immediately preceding the Relevant Contract Year;

c. I_{new} is the value for CPI most recently published prior to the first Calendar Day of the Relevant Contract Year; and

d. I_{old} is the value for CPI most recently published prior to the first Calendar Day of the Contract Year immediately prior to the Relevant Contract Year, or, in the case of the first occasion on which this calculation is carried out, the value of CPI most recently published prior to July 1,

provided that where I_{new} is less than or equal to I_{old}, then no calculation shall be carried out and V_{new} shall be deemed to be equal to V_{old}.

2.4. Resolution of Conflicts Among, and Prioritization of, Terms

2.4.1. Subject to Section 42.3, the Enterprises and Developer agree and expressly intend that this Agreement, which includes its Annex, Schedules and any valid amendments, constitutes a single, non-severable, integrated agreement whose terms are interdependent and non-divisible.

2.4.2. Subject to Sections 2.4.3, 2.4.4 and 2.4.5 and the express terms of this Agreement, any term, condition, requirement, criteria or specification set out or referenced in any part of this Agreement:

a. is a binding contractual obligation; and

b. with respect to Developer:

i. establishes minimum obligations; and

ii. shall not be construed to relieve Developer from its obligation to comply with all other terms, conditions, requirements, criteria and specifications, set out or referenced in any other part of this Agreement.

2.4.3. If there is any conflict, ambiguity or inconsistency between or among this Agreement (including the Annex, but excluding the Schedules) and the Schedules that cannot be reconciled by reading all parts of this Agreement and of the Schedules as mutually explanatory of one another, then the order of precedence shall be as follows:

a. this Agreement (including the Annex, but excluding the Schedules) shall prevail over any of the Schedules;

b. Schedule 17 (*Environmental Requirements*) shall prevail over all other Schedules;

c. the Alternative Technical Concepts[1] shall prevail over any other part of the Proposal Extracts and over any other Schedule (other than Schedule 17 (*Environmental Requirements*)); and

d. all the remaining Schedules shall equally prevail over the Proposal Extracts (other than the Alternative Technical Concepts);

provided that:

e. Changes made pursuant to Section 14 and amendments made pursuant to Section 43.1 shall prevail over such portions of this Agreement that they modify or amend;

f. in the event of any conflict, ambiguity or inconsistency between or among the provisions of this Agreement with an equal order of precedence, the most stringent requirement shall take precedence;

g. in the event of any conflict, ambiguity or inconsistency between the Project Standards that Developer is required to comply with pursuant to this Agreement and the Technical Requirements that cannot be resolved pursuant to Section 2.4.3.f, the relevant Technical Requirement shall take precedence;

h. notwithstanding anything to the contrary contained in this Agreement, in the event of any conflict, ambiguity or inconsistency between or among any applicable Federal requirement and any other requirement of this Agreement, the Federal requirement shall take precedence;

i. except where expressly referred to in this Agreement, the Financial Model and its contents shall not be used to interpret this Agreement and shall not otherwise affect the meaning of this Agreement; and

j. additional or supplemental details or requirements with a lower order of precedence relative to other parts of this Agreement as determined pursuant to this Section 2.4.3 shall be given effect (including, with respect to the Proposal Extracts, pursuant to Section 2.4.5) except to the extent such details or requirements conflict or are inconsistent with, or otherwise create an ambiguity in relation to, the provisions contained in a part of this Agreement with a higher order of precedence.

2.4.4. Developer shall notify the Enterprises promptly after it identifies or becomes aware of any conflict, ambiguity or inconsistency of a type described in Section 2.4.3. To the extent the Parties disagree on the reconciliation of any such conflict, ambiguity or inconsistency, the Enterprises may, in their discretion, notify Developer of their determination regarding such reconciliation, which determination shall be binding, unless such determination:

a. substantively amounts to a unilateral amendment to this Agreement or to a Change not made pursuant to Section 14; or

b. breaches the implied covenant of good faith and fair dealing.

2.4.5. If any part of Developer's Proposal includes statements, terms, concepts or designs that can reasonably be interpreted as offers:

[1] Depending on the nature and substance of the Preferred Proposer's Alternative Technical Concepts, some or all of such Alternative Technical Concepts may instead be treated as part of the Proposal Extracts pursuant to Section 2.4.3.d.

a. to provide higher quality items than otherwise required by this Agreement;

b. to adhere to more stringent requirements than otherwise required by this Agreement; or

c. to perform services or meet standards in addition to or better than those otherwise required under this Agreement,

then Developer's obligations hereunder shall include compliance and performance in accordance with such statements, terms, concepts and designs.

3. PROJECT INFORMATION, RELIANCE AND DILIGENCE

3.1. Limited Reliance on Project Information

3.1.1. Developer acknowledges and agrees that:

a. prior to the Setting Date, the Reference Documents (including, for certainty, the Reference Design) and certain other documents, information, reports and materials (together, the "Project Information") were made available to the Preferred Proposer for information only as contemplated in Section 2.5.1 of Part C of the ITP;

b. prior to the Agreement Date, the Preferred Proposer, the Core Proposer Team Members and Developer each conducted their own due diligence on the accuracy, completeness, relevance, fitness for purpose and adequacy of the Project Information;

c. the Reference Documents have not been incorporated into this Agreement either as a result of being listed in Schedule 29 (*Reference Documents*) or as a result of being referenced in any provision of this Agreement that requires Developer to comply with a specific Reference Document (or part thereof);

d. neither the Enterprises, nor any other Person that produced or provided any Project Information, gives or has given any representation and warranty, or made undertaking or guarantee, as to the accuracy, completeness, relevance, fitness for purpose or adequacy of any Project Information and as such:

i. Developer is not entitled to rely on any Project Information, except with respect to any Reference Document, to the extent such Reference Document is expressly made the basis for determining the occurrence of a Supervening Event; and

ii. subject to Section 3.4, neither the Enterprises, nor any other Person that produced or provided any Project Information, shall have any responsibility or liability to Developer or any other Developer-Related Entity in respect of, and Developer shall not be relieved of any obligation under this Agreement as a result of, any:

A. lack of accuracy, utility, completeness, relevance, fitness for purpose or adequacy of any kind whatsoever of any such Project Information;

B. any interpretations of, or conclusions drawn from, any such Project Information;

C. failure by the Enterprises, or by any other Person that produced or provided any such Project Information, to update such Project Information, the contents of which may reflect information available as of

the date that such Project Information was prepared or as of such other date indicated therein;

D. failure by the Enterprises or any other Person to reference or otherwise make available any materials, documents, drawings, plans or other information relating to the Project; or

E. causes of action or claims of, or Losses whatsoever suffered by, Developer or any other Developer-Related Entity by reason of any use of, or any action or forbearance in reliance on, such Project Information.

3.2. Responsibility for Independent Diligence

3.2.1. Sufficient diligence

Subject to the terms of this Agreement, Developer is deemed to have satisfied itself as to:

a. the sufficiency and condition of the Right-of-Way and of the Project License, and of all other property, assets and rights that it is entitled to receive under this Agreement;

b. the nature and extent of the risks assumed by it under this Agreement;

c. the sufficiency of the Preferred Proposer's and the Developer-Related Entities' opportunities to conduct due diligence, including in relation to the condition of each ROW Parcel, prior to the Setting Date pursuant to Good Industry Practice; and

d. the precautions and times and methods of working necessary to prevent or, if it is not possible to prevent, to mitigate or reduce any nuisance or interference, whether public or private, being caused to any third parties through the performance of the Work.

3.2.2. No reliance on unincorporated statements or representations and warranties

Developer acknowledges and agrees that:

a. it has not entered into this Agreement on the basis of, and has not relied upon, any statement, representation or warranty or other provision (in each case whether oral or written, express or implied) made or agreed to by the Enterprises or by any other Person, or any of their agents or employees, except those expressly repeated or referred to in this Agreement; and

b. the only remedies available in respect of any untrue statement, misrepresentation or breach of warranty made to Developer in this Agreement shall be any remedies expressly available under this Agreement.

3.3. Limitations on Site Condition Claims

Developer shall not be entitled to make any claim against the Enterprises or any other Person in relation to the condition of any ROW Parcel or any Additional ROW Parcel, or against the Enterprises or CDOT in relation to any Temporary Property or any Permit Area, except to the extent expressly provided for in this Agreement.

3.4. Residual Enterprise Liability

Nothing in this Section 3 shall exclude any liability which the Enterprises would otherwise have to Developer in respect of any statements, representations or warranties made fraudulently, recklessly or in bad faith or constituting willful misconduct.

PART B: EFFECTIVENESS AND TERM; REPRESENTATIONS AND WARRANTIES; FINANCIAL CLOSE; GRANT OF RIGHTS

4. EFFECTIVENESS AND TERM

4.1. Effectiveness

This Agreement (including Annex A (*Definitions and Abbreviations*) and the Schedules) shall come into effect on and from the Agreement Date.

4.2. Term

The "Term" shall commence on the Agreement Date and end on the earliest to occur of:

a. the Expiry Date; and

b. the Termination Date.

5. REPRESENTATIONS AND WARRANTIES

5.1. Representations and Warranties

5.1.1. Developer hereby represents and warrants to the Enterprises that each representation and warranty set out in Part 1 of Schedule 2 (*Representations and Warranties*) is true and correct as of the Agreement Date.

5.1.2. Each Enterprise hereby represents and warrants to Developer that each representation and warranty made by it and set out in Part 2 of Schedule 2 (*Representations and Warranties*) is true and correct as of the Agreement Date.

5.2. Mutual Reliance

Developer and each Enterprise acknowledge that, respectively, the Enterprises and Developer enter into this Agreement in reliance on the representations and warranties made pursuant to Section 5.1.

5.3. Notice of Untrue, Incorrect or Misleading Representations and Warranties

Notwithstanding that the representations and warranties made by the Parties pursuant to Section 5.1 are made and, pursuant to Schedule 1 (*Financial Close*), repeated, only at particular times:

a. Developer shall promptly inform the Enterprises after it becomes aware that any of its representations and warranties either was false, misleading or inaccurate in any material respect when made (or repeated) or omitted material information when made (or repeated); and

b. each Enterprise shall promptly inform Developer after it becomes aware that any of the representations and warranties made by it either was false, misleading or inaccurate in any material respect when made (or repeated) or omitted material information when made (or repeated).

5.4. Special Remedies for Mutual Breach of Warranty

If there exists or occurs any circumstance or event that constitutes or results in concurrent breaches of any of the parallel representations and warranties made pursuant to Section 5.1, or thereafter repeated pursuant to Schedule 1 (*Financial Close*), by Developer and one or both Enterprises, but which breaches do not also constitute or result in any other breach or default by either Party, including, subject to the passage of time and giving of notice, a Developer Default or an Enterprise Default, then:

a. such breaches shall not form the basis for a Supervening Event claim, or a damages claim by either Party against the other; and

b. each Party's only remedy shall be to:

i. take action as permitted under this Agreement to rectify or mitigate the effects of such circumstance or event;

ii. if applicable, exercise its rights to pursue severance and/or substitution of any invalid clause, condition, term, provision, section, subsection or part of this Agreement pursuant to Section 42.3;

iii. pursue a Termination by Court Ruling; and/or

iv. exercise their rights pursuant to Section 43.1.

5.5. Survival of Representations and Warranties

Pursuant to Section 41, each Party's liability with respect to its representations and warranties made pursuant to Section 5.1, or thereafter repeated pursuant to this Agreement, shall survive the end of the Term.

6. FINANCIAL CLOSE

6.1. Financial Close Process

The Parties agree to comply with their respective obligations with respect to the achievement of Financial Close pursuant to Schedule 1 (*Financial Close*).

6.2. Achievement of, or Failure to Achieve, Financial Close

6.2.1. Achievement of Financial Close shall have the effects set out in Schedule 1 (*Financial Close*).

6.2.2. A failure to achieve Financial Close by the Financial Close Deadline Date shall have the effects set out in, and may result in termination of this Agreement pursuant to, Schedule 1 (*Financial Close*).

7. GRANT OF RIGHTS AND PROJECT LICENSE

7.1. Grant of Right to Develop Project

Subject to the terms and conditions of this Agreement:

a. the Enterprises hereby grant to Developer the right to design, construct, finance, operate and maintain the Project in each case pursuant to this Agreement; and

b. Developer accepts such right and acknowledges its obligations under this Agreement,

in each case during the Term.

7.2. Developer's Project License

7.2.1. Grant of Project License

a. Subject to the terms and conditions of this Agreement:

i. the Enterprises grant to Developer a license (the "Project License") over, under, upon and in the Right-of-Way, and any Additional Right-of-Way, for the sole purpose of exercising its rights and performing its obligations under this Agreement pursuant to the terms hereof; and

ii. Developer acknowledges and accepts such Project License.

b. Without limiting Developer's conditional, limited rights to obtain early access to (but, for certainty, not Possession of) ROW Parcels pursuant to Section 1.2 of Schedule 18 (*Right-of-Way*), the Enterprises shall deliver, and Developer shall be entitled to have, Possession of:

i. each ROW Parcel on and from the Possession Date specified in the Notice of Possession with respect to such ROW Parcel until such ROW Parcel's Project License End Date; and

ii. any Additional ROW Parcel on and from the Possession Date specified in the Notice of Possession with respect to such Additional ROW Parcel until such Additional ROW Parcel's Project License End Date.

c. The Project License shall automatically be revoked upon the occurrence of the end of the Term.

7.2.2. Sublicensing

Developer shall have the right to issue sub-licenses under the Project License to Subcontractors as necessary to carry out Developer's obligations under this Agreement.

7.2.3. Limitations and qualifications on the grant of rights and Project License

a. The Project License is personal property, and not an interest in real property, and shall not be recorded in the City of Denver's Clerk and Recorder's Office or in any other county.

b. Developer shall not use any part of the Site, or exercise its rights with respect to the Project License, in either case, for any purpose other than carrying out its obligations under this Agreement.

c. Developer's interest in the Right-of-Way, and any Additional Right-of-Way, is limited by the Project License and the other terms and conditions of this Agreement. Developer is not and shall not be, and shall not be treated as or be deemed to be, the legal or equitable owner of the Right-of-Way, or any Additional Right-of-Way, in whole or in part, for any purpose.

d. This Agreement does not, and shall in no way be deemed to, constitute a lease (regardless of the characterization of such lease, including as an operating lease or a financing lease) to Developer or, except as expressly provided in Section 7.1, a grant (regardless of the characterization of such grant, including by way of easement, purchase option, conveyance, lien or mortgage), in each case, of any right, title, interest or estate, including any fee simple, leasehold estate, easement or property interest of any kind, in or to the Right-of-Way, any Additional Right-of-Way, the Project or of any Assets incorporated into, or appurtenant to, the Project.

e. Without limiting its rights under this Agreement with respect to any Compensation Event of the kind described in paragraph b. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*), Developer acknowledges and agrees that its Possession of each ROW Parcel and any Additional ROW Parcel pursuant to Section 7.2.1.b is subject to the rights of access and use of certain third parties. Developer shall reasonably facilitate access to and through the Site by all Persons with such rights of access and use, and shall not take any action (or refrain from taking any action) in a manner that is calculated or intended to directly or indirectly prejudice or frustrate or make more difficult such rights of access and use.

7.3. Ownership and Liability

7.3.1. Right-of-Way

All of the Right-of-Way, and any Additional Right-of-Way, shall be held or acquired, as applicable, in the name of CDOT (or in such other name(s) as the Enterprises may otherwise determine in their discretion). Subject to the terms of this Agreement, the Enterprises reserve to themselves and their designees, including CDOT, the rights of use, occupancy and, as applicable, ownership over, under, upon and in the Right-of-Way and any Additional Right-of-Way.

7.3.2. Developer's responsibilities

Following either Developer's right of Possession extending to a ROW Parcel or any Additional ROW Parcel pursuant to Section 7.2.1.b (and for such period of time as Developer is entitled to have Possession thereto pursuant to such Section), or Developer's acquisition of any interest or right with respect to any Temporary Property or Permit Area (and for such period of time as such interest or right is maintained), Developer shall (as among the Parties):

a. have sole responsibility for such part of the Site (and for all Elements located thereon), including risk of damage and loss; and

b. bear any costs and expenses incurred in relation to such part of the Site (and in relation to all Elements located thereon), including all fees, expenses and taxes associated with such part of the Site,

subject to the express terms of this Agreement.

7.3.3. Transfer of Ownership

a. With respect to any part of any Element that is to be affixed to any ROW Parcel or any Additional ROW Parcel (or any infrastructure already affixed thereto) as part of the Project, ownership of and title to each such part shall automatically vest in CDOT (or, in the Enterprises' discretion, their designee) free from all Encumbrances, other than Permitted Encumbrances, immediately upon such part being affixed thereto.

b. Notwithstanding Section 7.3.3.a:

i. the vesting of ownership of and title to any part of any Element pursuant to Section 7.3.3.a shall not imply acceptance of such part by the Enterprises (or by such part's current or future owner) as to the compliance of such part with the requirements set out in this Agreement, nor shall Developer be relieved of its obligation to comply with any of its obligations under this Agreement with respect to such Element, the Work or otherwise; and

ii. subject to the terms of this Agreement, the risk of loss or damage to such part of any Element shall remain with Developer pursuant to Section 7.3.2.

c. Developer shall not do any act or thing that will create any Encumbrance (other than a Permitted Encumbrance) against any Element (or part thereof), or any part of the Right-of-Way or of any Additional Right-of-Way, and shall promptly remove any such Encumbrance (including a Permitted Encumbrance under paragraph b. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*), but excluding any other Permitted Encumbrances), unless such Encumbrance came into existence as a result of an act of or omission by the Enterprises or CDOT, or a Person claiming through any of them, which in turn was not caused by an act or omission of Developer or any other Developer-Related Entity.

PART C: OBLIGATIONS TO DESIGN, CONSTRUCT, OPERATE, MAINTAIN AND HANDBACK THE PROJECT

8. DEVELOPER'S PROJECT OBLIGATIONS

8.1. General Undertakings

8.1.1. Developer hereby undertakes to perform the Work pursuant to and in compliance with:

a. the terms, conditions and requirements of this Agreement, including each of the Schedules;

b. the Project Standards;

c. Law;

d. all Governmental Approvals and all Permits in effect from time to time; and

e. Good Industry Practice.

8.1.2. Furthermore, Developer hereby undertakes that it shall:

a. not adopt or, once adopted, change its legal form or name of organization without the Enterprises' prior consent, such consent:

i. in the Enterprises' discretion, if such change would adversely affect the Enterprises' rights, obligations or interests under this Agreement or with respect to the Project; and

ii. otherwise, not to be unreasonably withheld;

b. not carry out any business or other activities other than business and activities solely related to the performance of its obligations pursuant to this Agreement in relation to the Project;

c. not permit any other Person to carry out any business activities on the Site or in relation to the Project, except as expressly permitted by this Agreement;

d. not commit or otherwise facilitate, and not permit any other Developer-Related Entity to commit or otherwise facilitate, the commission of any Prohibited Acts; and

e. subject to any rights of Developer arising as a result of the occurrence of any Change or Supervening Event, bear all risk, including of delay and/or increased cost, resulting from or arising out of any differences between its design for any portion of the Project and the Reference Design.

8.1.3. Without limiting its other obligations under this Agreement, Developer shall, at its sole cost and expense (except as otherwise expressly provided for in this Agreement), cooperate and coordinate with the Enterprises, CDOT and all other Governmental Authorities with jurisdiction in matters relating to the Work, including their review, inspection and oversight of the Project.

8.2. Assumption of Risk and Responsibility

Except to the extent otherwise expressly provided for in this Agreement (including as the result of the occurrence of any Change or Supervening Event), all risks, costs and expenses in relation to the performance by Developer of its obligations under this Agreement and of the Work are allocated to, and accepted by, Developer as its entire and exclusive responsibility. As among the Parties, Developer shall be solely responsible for the selection, pricing and performance of all Subcontractors and all other Persons for whom or for which Developer is responsible by contract or pursuant to Law, and for the acts, defaults, omissions, breaches and negligence of the same, as fully as if any such acts, defaults, omissions, breaches or negligence were those of Developer.

8.3. Federal and State Requirements

8.3.1. Compliance with Federal requirements

a. Developer shall, and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall, comply with all Federal requirements applicable to transportation projects that receive Federal credit or funds, including the requirements set out in Part A of Schedule 15 (*Federal and State Requirements*).

b. In the event of any conflict between any applicable Federal requirement and the other requirements of this Agreement, Section 2.4.3.h shall apply.

8.3.2. False or fraudulent statements and claims

a. Developer recognizes that the requirements of the Program Fraud Civil Remedies Act of 1986, 31 U.S.C. § 3801 et seq., and the US DOT regulations, "Program Fraud Civil Remedies," 49 CFR Part 31, apply to its actions under this Agreement.

b. Accordingly, by signing this Agreement, Developer certifies and affirms the truthfulness and accuracy of any claim, statement, submission or certification it has made, it makes, or it may make pertaining to this Agreement.

c. Developer acknowledges that if it makes a false, fictitious or fraudulent claim, statement, submission or certification, then in addition to any other penalties that may be applicable, the Federal government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986, 31 U.S.C. § 3801 et seq., on Developer to the extent the Federal government deems appropriate.

8.3.3. Federal status of Project

a. Developer acknowledges that:

i. the FHWA has designated the Project as a "Major Project" under 23 U.S.C. § 106, which designation requires submission by the Enterprises to, and approval by, FHWA of a project management plan and an annually updated finance plan as provided in 23 U.S.C. § 106(h); and

ii. portions of the Project are and will be part of the National Highway System, as defined in 23 CFR § 470.

b. Accordingly, Developer acknowledges and agrees that the Enterprises may submit documents based on or including Project Records to the FHWA in order for the Enterprises to comply with the requirements of 23 U.S.C. § 106(h).

8.3.4. Emergency Repair Work

a. Developer shall solicit competitive bids for temporary and/or permanent repair work that results from an Emergency (of a type defined in paragraphs d. and e. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*) ("Emergency Repair Work")) if FHWA's or FEMA's or any other equivalent Governmental Authority's applicable regulations, policies or procedures require competitive bidding in order for the Enterprises to obtain reimbursement for eligible costs.

b. Developer shall:

i. ensure that any Emergency Repair Work is performed pursuant to the requirements of this Agreement, Law and FHWA's, FEMA's and any other equivalent Governmental Authority's applicable regulations, policies or procedures, including (as applicable) the FHWA's "Emergency Relief Manual"; and

ii. without limiting Developer's obligations under Section 19, maintain estimates, cost records and supporting documentation pursuant to such applicable regulations, policies or procedures, and otherwise in form and substance as reasonably required by the Enterprises.

c. Without limiting Developer's obligations under Sections 8.3.4.a and 8.3.4.b, the Enterprises may, in their discretion, provide oversight of Emergency Repair Work as may be required by FHWA, FEMA or any other equivalent Governmental Authority, or by Law, to preserve eligibility for reimbursement of eligible costs.

8.3.5. Restrictions on communications with FHWA and US DOT

Developer shall only communicate with the FHWA and the US DOT indirectly through the Enterprises, except:

a. with respect to the TIFIA Financing;

b. as required by Law;

c. as expressly permitted or required by this Agreement; or

d. with the Enterprises' prior Approval,

in each of which cases Developer shall provide the Enterprises with regular written updates, in form and substance reasonably satisfactory to the Enterprises, regarding such communications.

8.4. Governmental Approvals and Permits

8.4.1. Department Provided Approvals

The Department Provided Approvals were obtained prior to the Agreement Date by CDOT and, subject to Section 8.4.3.b, shall be maintained by the Enterprises, acting in coordination with CDOT, at their cost and expense.

8.4.2. Developer's responsibility to obtain Governmental Approvals and Permits

a. Subject to Section 8.4.4.a, Developer shall be responsible for obtaining all Governmental Approvals (other than the Department Provided Approvals) and all Permits, and for arranging any necessary amendments to any Governmental Approvals (including, pursuant to Section 8.4.3.b, Department Provided Approvals) and any Permits, in each case as necessary to perform its obligations hereunder at the time and in the manner when they fall due for performance.

b. Developer's obligations under Section 8.4.2.a shall not be limited by any Law placing responsibility for the same upon either or both of the Enterprises, CDOT or another Person.

8.4.3. Process for obtaining and modifying Governmental Approvals

a. Prior to submitting to any Person an application for a Governmental Approval or Permit (or for any proposed termination, modification, renewal, extension or waiver of a Governmental Approval or Permit), Developer shall first submit the same, together with any supporting environmental or other studies, analyses and data, to the Enterprises:

i. with respect to all such submissions to be made to the FHWA, for Approval;

ii. with respect to all such submissions that involve a Department Provided Approval, for Approval; and

iii. with respect to all other submissions, to the extent not otherwise required pursuant to the Technical Requirements or Schedule 14 (*Strategic Communications*) to be submitted for Approval or Acceptance, for Information.

b. Subject to Developer's rights arising as a result of the occurrence of any Change or Supervening Event, as between the Enterprises and Developer, Developer shall perform all necessary actions and shall bear all risk of delay and/or all risk of increased cost, in either case, associated with Governmental Approvals (including, for certainty, Department Provided Approvals) and with Permits, including:

i. without limiting the Enterprises', CDOT's and FHWA's rights to independently evaluate all environmental and other studies and documents and fulfill the other responsibilities assigned to them by 23 CFR Part 771, conducting all necessary environmental or other studies and preparing all necessary environmental or other documents in compliance with Law (provided that the Enterprises may, in their discretion, elect to conduct any such studies or to prepare any such documents at Developer's cost);

ii. obtaining and complying with all necessary new Governmental Approvals and Permits, or all necessary modifications, renewals and extensions of existing Governmental Approvals and Permits, or of pending applications for Governmental Approvals and Permits; and

iii. all risk and cost of litigation,

where such risk of delay and/or risk of increased cost:

iv. relates to:

A. a Governmental Approval that is not a Department Provided Approval; or

B. a Permit; or

v. relates to any Governmental Approval (including any Department Provided Approval) or any Permit and results from:

A. any differences between Developer's design and the Reference Design;

B. differences between the design, construction, operations and/or maintenance means and methods Developer chooses for any portion of the Project and those set out, referred to or contemplated in any Governmental Approval (including, for certainty, any Department Provided Approval) or Permit, or in the application for any Governmental Approval or Permit; and/or

C. the acquisition of any Additional ROW Parcel, Developer-risk Permit Area or Temporary Property Rights.

c. If Developer is unable to obtain, modify, renew or extend any Governmental Approval or Permit, then Developer shall promptly notify the Enterprises and proceed or continue to design, build, operate and maintain the Project according to the requirements of this Agreement and the design, construction, operations and maintenance means and methods set out, referred to or contemplated in the Department Provided Approvals, and any other Governmental Approvals and any Permits that have been or are subsequently obtained. No such inability shall:

i. itself constitute a Change, Supervening Event or other basis for any claim or relief hereunder by or for Developer; or

ii. be, or be deemed to be, a breach by the Enterprises of this Agreement, including of any of the representations and warranties made by each of them pursuant to Section 5.1.2 or, pursuant to Schedule 1 (*Financial Close*), subsequently repeated.

8.4.4. Enterprise assistance in obtaining and modifying Governmental Approvals and Permits

a. The Enterprises shall, at the reasonable request of Developer, where necessary to obtain, modify, renew or extend any Governmental Approval or Permit for which Developer is otherwise responsible pursuant to this Section 8.4, use Reasonable Efforts to:

i. execute (or, as applicable, facilitate execution by CDOT of) such documents as can only be executed by the Enterprises or, as applicable, CDOT;

ii. make such applications (or, as applicable, facilitate such applications by CDOT), either in its own name or jointly with Developer, as can only be made by the Enterprises or, as applicable, CDOT, or in joint names of Developer and the Enterprises or, as applicable, CDOT; and

iii. attend meetings and cooperate with approval bodies as reasonably requested by Developer (or, as applicable, facilitate such attendance and cooperation by CDOT), in each case within a reasonable period of time after being requested to do so by Developer.

b. Subject to any pre-agreed scope of Work and budget and to any rights of Developer that arise as a result of the occurrence of any Change or Supervening Event, Developer shall

fully reimburse the Enterprises for all costs and expenses they and, as applicable, CDOT, incur in providing cooperation and assistance pursuant to Section 8.4.4.a, provided that, except to the extent provided pursuant to Section 8.4.3.b, Developer shall not be responsible for the payment of the Enterprises' and, as applicable, CDOT's costs and expenses incurred in obtaining, modifying, renewing or extending any Department Provided Approval.

8.5. Third Party Agreements

8.5.1. Compliance with Third Party Agreements and performance of related Work

Developer shall, and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall, perform its and their obligations under this Agreement or any Subcontract in a manner that is consistent with, and does not impair the parties thereto from performing their obligations under, the Third Party Agreements.

8.5.2. Restrictions on new third party agreements

Developer shall not, without the Enterprises' prior Approval, enter into, and shall ensure that no other Developer-Related Entity enters into, any agreement with any Governmental Authority, Utility Owner, Railroad, property owner or other third party having regulatory jurisdiction over any aspect of the Project or Work, or having any property interest affected by the Project or the Work, that in any way purports to, or reasonably could be interpreted to, obligate the Enterprises, CDOT or the State.

8.6. Compliance with Project Standards

8.6.1. Monitoring of Project Standards

a. Developer shall, and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall, monitor and familiarize themselves with changes or additions to, or replacements of, the Project Standards.

b. Developer shall notify the Enterprises of any change or addition to, or replacement of, any Project Standard promptly after it becomes aware of such change, addition or replacement.

8.6.2. Changes, additions or replacements to or of Construction Standards

a. Subject to Section 8.6.2.b, Developer shall not be required to comply with any change or addition to, or replacement of, a Construction Standard, unless the Enterprises issue an Enterprise Change in their discretion.

b. If and to the extent that compliance by Developer with any change or addition to, or replacement of, a Construction Standard is required for Developer's continued compliance with Law (the burden of establishing which shall be on Developer), but without limiting Developer's obligation to at all times comply with Law, the Enterprises shall issue an Enterprise Change to require compliance by Developer with such change, addition or replacement to or of a Construction Standard.

9. DEVELOPER'S CONSTRUCTION PERIOD OBLIGATIONS

9.1. Obligation to Carry Out and Complete

Developer shall carry out and complete:

a. the NTP1 Work on and from (but (other than, for certainty, conducting preparatory activities that, after issuance of NTP 1, will comprise NTP1 Work) not prior to) the date of issuance of NTP1;

b. subject to Section 9.1.a, all Construction Work and all O&M Work During Construction (other than the performance of Snow and Ice Control Services) on and from (but not prior to) the date of issuance of NTP2; and

c. Snow and Ice Control Services, on and from (but not prior to) the date of issuance of NTP3,

pursuant to and in compliance with the terms, conditions and requirements of this Agreement.

9.2. Schedule Management, Completion and Commissioning

9.2.1. Milestone Completion, Substantial Completion and Final Acceptance

a. Developer shall achieve:

i. Milestone Completion of each Payment Milestone;

ii. Substantial Completion by the Baseline Substantial Completion Date, following which it will cease to perform O&M Work During Construction and, pursuant to Section 10, begin to perform the O&M Work After Construction; and

iii. Final Acceptance by the Final Acceptance Deadline Date.

b. The Baseline Substantial Completion Date and the Final Acceptance Date shall only be extended pursuant to this Agreement as agreed or determined either pursuant to a Change or following the occurrence of a Supervening Event.

9.2.2. Project Schedule

Notwithstanding anything to the contrary in this Agreement, including Section 9.2.1.a and without prejudice to the rights of the Enterprises:

a. that arise as a result of the Noncompliance Event specified in item 2.32 of Table 6A.2; or

b. that arise as a result of the occurrence of Developer Default number (6),

Developer's failure to comply with the Project Schedule (including its failure to comply with Sections 9.2.1.a.ii or 9.2.1.a.iii) in carrying out the Construction Work shall not constitute a breach of this Agreement or a Developer Default.

9.2.3. Float

a. Float shall be considered as a jointly owned, expiring resource available to the Project for the benefit of all Parties (and not for the exclusive benefit of either the Enterprises or Developer), available to each of them as needed to absorb delays caused by

Supervening Events or other events to achieve interim completion dates and deadlines set out in the Project Schedule and, ultimately, to achieve Substantial Completion by the Baseline Substantial Completion Date and Final Acceptance by the Final Acceptance Deadline.

b. Notwithstanding Section 9.2.3.a, Float shall not be available to the Enterprises to absorb delays caused by the occurrence of a Compensation Event as described in paragraphs a., b., e., h. and j. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*).

9.3. Payment and Performance Security

9.3.1. Obligation to obtain and maintain Contractor Bonds

a. Developer shall deliver to the Enterprises Contractor Bonds with respect to:

i. collectively, the Construction Work and O&M Work During Construction;

ii. the performance of any Work with respect to the Warrantied Elements during the Warranty Period; and

iii. O&M Work After Construction,

in each case as and when required pursuant to Schedule 3 (*Commencement and Completion Mechanics*).

b. Thereafter, Developer shall ensure that each such Contractor Bond shall remain in full force and effect, and in full compliance with the definition of Contractor Bond set out in Part A of Annex A (*Definitions and Abbreviations*), provided that, subject to Sections 9.3.1.c and 9.3.3 and the terms of the Principal Subcontractor Direct Agreements, promptly following the earlier of the Termination Date and:

i. the Final Acceptance Date, the Enterprises shall release or return to Developer each Contractor Bond delivered pursuant to Section 9.3.1.a.i;

ii. the end of the Warranty Period (as extended pursuant to Section 9.4.3), the Enterprises shall release or return to Developer each Contractor Bond delivered pursuant to Section 9.3.1.a.ii; and

iii. the Expiry Date, the Enterprises shall release or return to Developer each Contractor Bond delivered pursuant to Section 9.3.1.a.iii.

c. Notwithstanding Section 9.3.1.a, Developer acknowledges and agrees that, to the extent required by Law in connection with Work to be performed during the Term, or as otherwise required in connection with a Change, Developer shall obtain and maintain additional Contractor Bonds in such amounts and for such periods of time as required by Law or in connection with a Change.

9.3.2. Methods of providing Contractor Bonds

Developer may, in its discretion, satisfy its obligations to provide Contractor Bonds under Sections 9.3.1.a and 9.3.1.c by:

a. procuring such Contractor Bonds directly so that such bonds are security for:

i. Developer's performance obligations to the Enterprises (and, with respect to each Contractor Bond delivered pursuant to Section 9.3.1.b.ii, to each Warranty Beneficiary) under this Agreement; and

ii. Developer's payment obligations to Subcontractors and laborers,

in which case the Enterprises (and, with respect to each Contractor Bond delivered pursuant to Section 9.3.1.b.ii, each Warranty Beneficiary) shall be the primary obligees and the Lenders, or their Collateral Agent, may be additional obligees; or

b. procuring such Contractor Bonds from its Principal Subcontractors so that such bonds are security for:

i. such Principal Subcontractor's performance obligations to Developer under its Subcontract; and

ii. such Principal Subcontractor's payment obligations to lower tier Subcontractors and to laborers,

in which case the Enterprises (and, with respect to each Contractor Bond delivered pursuant to Section 9.3.1.b.ii, each Warranty Beneficiary) shall be, and the Lenders or their Collateral Agent may be, additional obligees.

9.3.3. Payment and Performance Security following Developer Default

Upon the occurrence of a Developer Default and expiration, without full and complete cure, of the applicable Developer Default Cure Period (subject to extension pursuant to Section 32.1.2), if any, the Enterprises shall, subject to the terms of the Lenders Direct Agreement, be entitled in their discretion to make demand upon and enforce any Contractor Bond in accordance with its terms. Any such demand shall not waive, or release Developer from, any obligations under this Agreement. The Enterprises will apply the proceeds of any such action to the satisfaction of Developer's obligations under this Agreement, including payment of amounts due to the Enterprises.

9.4. Warranties and Liability for Defects

9.4.1. Warranties

Developer warrants that each Warrantied Element:

a. shall be designed, constructed and completed in a manner that:

i. complies with Good Industry Practice; and

ii. meets or exceeds all other applicable requirements of this Agreement;

b. shall, except as otherwise expressly permitted under this Agreement, be comprised of new materials; and

c. shall be suitable for the intended purpose, of good quality and free from faults and Defects,

(a., b. and c., together with the Additional Warranties, the "Warranties").

9.4.2. Warranty Beneficiaries

a. In addition to the Enterprises, the Warranties are for the express benefit of CDOT, the City of Denver, Denver Public Schools and the Cover Maintainer (such third parties together, the "Warranty Beneficiaries"), and the Warranty Beneficiaries shall have full rights as third party beneficiaries to enforce the Warranties and receive the full benefit of the Warranties, with respect to those Warrantied Elements to be respectively operated and/or maintained by them, and Developer agrees that:

i. each of the Warranty Beneficiaries is, with respect to those Warrantied Elements to be operated and/or maintained by such Warranty Beneficiary, a third-party beneficiary of the Warranties provided under this Section 9.4 with a right of enforcement; and

ii. notwithstanding Section 9.4.2.a.i, the Enterprises may elect, at their discretion, to enforce such Warranties on behalf of any Warranty Beneficiary to recover any Loss suffered by such Person.

b. The rights and remedies of the Enterprises and the Warranty Beneficiaries arising with respect to any breach of the Warranties shall not limit Developer's liability or responsibility, or the Enterprises' rights and remedies, under this Agreement or Law with respect to the Work, including with respect to any Defect, Nonconforming Work, Noncompliance Event, Non-Permitted Closure, breach, fraud, willful misconduct, criminal conduct, recklessness, bad faith or negligence

9.4.3. Warranty Period

a. Subject to Section 9.4.3.b:

i. the Warranties (other than the Additional Warranties) shall remain in effect until the first anniversary (or, with respect to Warranties for the benefit of Denver Public Schools or the Cover Maintainer, the second anniversary) of the Final Acceptance Date; and

ii. the Additional Warranties shall remain in effect until the expiry date of the required warranty period in accordance with Schedule 10 (*Design and Construction Requirements*),

in the case of each Warranty, the "Warranty Period".

b. Following Approval by the Enterprises of any work performed to remedy a Defect or any other breach of the Warranties in relation to a Warrantied Element, or, as applicable, approval in the discretion of a Warranty Beneficiary of any Warranty work performed to remedy a Defect in relation to any Warrantied Elements maintained by it, the Warranties as to each affected Warrantied Element shall automatically extend beyond the original Warranty Period to the extent less than one year remains of such original period, such that that each affected Warrantied Element shall have a one-year extended Warranty Period ending on the first anniversary of such Approval or approval.

9.4.4. Developer obligation to remedy Warrantied Elements

a. Developer shall (at its own risk, cost and expense, including the risk, cost and expense of associated design work) promptly investigate, repair, replace or otherwise correct and fully remedy any Defect in the Warrantied Elements or any other breach of the Warranties notified to it by the Enterprises or any Warranty Beneficiary prior to the expiry

of the applicable Warranty Period (including, for certainty, as such period may be extended pursuant to Section 9.4.3).

b. Developer acknowledges and agrees that the Enterprises, CDOT and each Warranty Beneficiary may perform work on any Warrantied Element during the Warranty Period, to the extent they or it otherwise have or has rights to do so, without voiding any Warranty, provided that Developer does not hereby waive any rights, claims or remedies to which it may otherwise be entitled as a result of such work.

9.4.5. Warranty Defects List

a. At any time prior to the expiry of the applicable Warranty Period (including, for certainty, as extended pursuant to Section 9.4.3) the Enterprises and, with respect to any Warrantied Element maintained by it, each Warranty Beneficiary shall, in their discretion, have the right to access and conduct an inspection of each Warrantied Element. Following such inspection, each Warranty Beneficiary shall, with respect to any Warrantied Element maintained by it, shall have the right, but not the obligation, to identify Defects in relation to the relevant Warrantied Element or any other breaches of the Warranties and to prepare and deliver to Developer a list of such Defects and breaches (the "Warranty Defects List") and a required date of completion of the required Warranty work, provided that:

i. the Enterprises, in consultation with any relevant Warranty Beneficiary, may in their discretion also prepare and deliver a Warranty Defects List; and

ii. any such list, whether prepared by a Warranty Beneficiary at the Enterprises, shall be delivered to Developer prior to the expiry of the applicable Warranty Period.

b. Developer shall notify the Enterprises and, with respect to any Warrantied Elements maintained by it, each Warranty Beneficiary, within five Working Days of receipt of any Warranty Defects List whether it agrees with or disputes the contents of such Warranty Defects List. If Developer fails to provide such notice within such period, then Developer shall be deemed to agree with the contents and requirements of such Warranty Defects List.

c. Developer shall reimburse the Enterprises and, as applicable, each Warranty Beneficiary for all costs and expenses incurred in conducting an inspection pursuant to Section 9.4.4, or otherwise pursuant to this Agreement, that identifies a Defect in the Warrantied Elements or any other breach of the Warranties.

9.4.6. Assignment of Warranties

In addition to the Warranties, including all Additional Warranties, Developer shall in accordance with Good Industry Practice procure for itself customary and available supplier, manufacturer and other third party warranties. Developer shall ensure that such warranties are fully transferrable and assignable to the Enterprises upon the Expiry Date or, if earlier, the Termination Date.

9.5. Assignment of Certain Causes of Action

Developer agrees to assign to the Enterprises all rights, title, and interest in and to all causes of action Developer may have under Section 6 of the Clayton Act (15 U.S.C. § 15) or under comparable State Law, arising from purchases of goods, services or materials pursuant to this Agreement. This assignment shall be made and become effective automatically upon payment of the Substantial Completion Payment, without further acknowledgment by the Parties.

10. DEVELOPER'S OPERATING PERIOD OBLIGATIONS

Developer shall carry out the O&M Work After Construction on and from the Substantial Completion Date pursuant to and in compliance with the terms, conditions and requirements of this Agreement.

11. PAYMENTS IN CONSIDERATION OF WORK PERFORMED

11.1. Milestone Payments

The Enterprises shall pay the Milestone Payments to Developer in accordance with Part 1 of Schedule 4 (*Payment*) and Schedule 5 (*Milestone Payment*).

11.2. Performance Payments

The Enterprises shall pay the Performance Payments to Developer in accordance with Part 2 of Schedule 4 (*Payment*) and Schedule 6 (*Performance Mechanism*).

12. COOPERATION AND COORDINATION WITH RELATED TRANSPORTATION FACILITIES DURING THE TERM

12.1. Duty to Cooperate and Coordinate

12.1.1. Without limiting its other obligations under this Agreement, Developer shall:

a. cooperate and coordinate with the Enterprises, CDOT and any relevant third party as reasonably requested by the Enterprises, with regard to the design, construction, operation and/or maintenance of, respectively, the Project and the Related Transportation Facilities, including with regard to Department Retained Maintenance, and

b. otherwise use Reasonable Efforts in order to minimize any adverse impact:

i. on the Work or the operation of the Project as a result of the design, construction, operation and/or maintenance of any Related Transportation Facility, including with regard to Department Retained Maintenance, and

ii. on any Related Transportation Facility, including with regard to Department Retained Maintenance, as a result of the Work.

12.1.2. Developer shall not block, hinder, change or restrict, partially or wholly, access to or from the Project from or to any Related Transportation Facility, including any Other Department Project, without the prior express written consent of, and on such terms and conditions as may be specified by, the Enterprises, CDOT or any other applicable Governmental Authority.

12.2. Compatibility and Integration with Related Transportation Facilities

Developer shall:

a. locate, configure, design, construct, operate and maintain the endpoints, interfaces, interchanges, ramps, intersections, crossings, entrances and exits of the Project so that the Project will be compatible and integrated with the location, configuration, design, operation and maintenance of, and provide a smooth, safe and orderly transition of traffic to and from, Related Transportation Facilities; and

b. design the Project to include and provide for such compatibility, integration and transition with, to and from Related Transportation Facilities.

12.3. Procurement of Other Department Projects

12.3.1. In response to the Enterprises' written request, Developer shall inform the Enterprises within 10 Working Days of such request of all material facts or circumstances of which it is aware that might reasonably be expected to affect the procurement, design, construction, operation or maintenance of any Other Department Project, or any other Related Transportation Facility, in the light of the details concerning such project or facility that the Enterprises have provided to Developer or that are otherwise available to Developer.

12.3.2. If the Enterprises are preparing to issue or have issued any Other Department Project Procurement Materials or are otherwise seeking offers from any Person or negotiating with any Person in respect of any proposed Other Department Project, then Developer shall use Reasonable Efforts as the Enterprises may reasonably request to assist such procurement, including providing access to the Enterprises, CDOT and each of their respective designees to:

a. each part of the Site for the purpose of surveying, inspecting or investigating the relevant parts thereof (provided that the Enterprises shall, and shall require that other parties requiring access at the Enterprises' request shall, at all times comply with all relevant site rules in relation to the Site); and

b. Project Records, but only to the extent that the Enterprises may otherwise require Developer to deliver or to procure the delivery of such records under the terms of this Agreement,

in each case solely and to the extent necessary to procure and award the relevant Other Department Project.

12.3.3. If the Enterprises or CDOT award or otherwise undertake any Other Department Project other than with Developer, then Developer shall:

a. cooperate and coordinate with the Enterprises, CDOT and each of their respective designees engaged in such Other Department Project as required pursuant to Section 12.1.1;

b. not take any action (or refrain from taking any action) in a manner that is calculated or intended to directly or indirectly prejudice or frustrate or make more difficult such Other Department Project; and

c. at reasonable times and upon reasonable notice, allow access to the Enterprises, CDOT and each of their respective designees to each part of the Site as is reasonably necessary to facilitate the carrying out of and interface with the Other Department Project (provided that the Enterprises shall, and shall require that CDOT and all other parties requiring access shall, at all times comply with all relevant site rules in relation to the Site), provided such access is not reasonably anticipated to adversely affect the Work,

provided that Developer shall not be required to take (or refrain from taking) any action that would reasonably be anticipated to materially adversely affect the Work or the carrying out of Developer's other obligations under this Agreement.

12.4. Enterprises' Assistance

The Enterprises shall:

a. at reasonable times and upon reasonable notice, and subject to CORA, provide to Developer reasonable access to plans, surveys, drawings, specifications, reports and other documents and information in the possession of, or otherwise accessible by, the Enterprises pertaining to Related Transportation Facilities and Other Department Projects, including the ability for Developer, at its expense, to make copies of the same; and

b. at Developer's request, provide reasonable assistance to Developer in fulfilling its obligations under Sections 12.1 through 12.3, provided that:

   i. in no event shall the Enterprises be required to bring any legal action or proceeding against any third party; and

   ii. Developer shall reimburse the Enterprises for all costs and expenses that they incur in connection with rendering such assistance.

12.5. Traffic Management

Developer acknowledges that the Enterprises, CDOT, the City of Denver, Emergency Services and other Governmental Authorities with traffic management authority under Law, shall have, without obligation or liability to Developer, the right to conduct traffic management activities pursuant to standard practices and procedures in effect from time to time, and without prior notice:

a. on the Right-of-Way, any Additional Right-of-Way and any other part of the Site that is open for use by the traveling public;

b. on any Related Transportation Facility; and

c. in connection with any Other Department Project,

which activities shall not, for certainty, themselves constitute a Supervening Event.

13. HANDBACK

Developer shall prepare to hand back the Project, and at the Expiry Date hand back the Project, in accordance with its obligations under Schedule 12 (*Handback*).

PART D: CHANGES AND SUPERVENING EVENTS

14. CHANGES

14.1. Right to Initiate Changes

Subject to the limitations set out in Schedule 24 (*Change Procedure*), either Party may propose a Change by submitting a notice to the other Party. Such a notice:

a. submitted by the Enterprises to Developer (an "Enterprise Change Notice") shall be processed pursuant to Schedule 24 (*Change Procedure*); and

b. submitted by Developer to the Enterprises (a "Developer Change Notice") shall be processed pursuant to Schedule 24 (*Change Procedure*).

15. SUPERVENING EVENTS

15.1. Submission of Supervening Event Notices and Claims

15.1.1. Developer shall (and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall) develop and maintain procedures pursuant to Good Industry Practice to anticipate, identify and (in the case of Subcontractors) notify Developer of the occurrence of Supervening Events.

15.1.2. If Developer becomes aware or determines that a Supervening Event has occurred or is likely imminent, then, subject to Section 15.1.3, it shall

a. promptly, and in any event within two Working Days of becoming aware of such occurrence or making such determination that such event is likely imminent, submit to the Enterprises a notice in the form provided in Schedule 21 (*Forms of Supervening Event Submissions*) (a "Supervening Event Notice"); and

b. thereafter, and to the extent a Supervening Event has occurred:

i. promptly, and in any event within 15 Working Days of becoming aware of such occurrence, submit to the Enterprises a claim in the form provided in Schedule 21 (*Forms of Supervening Event Submissions*) (a "Preliminary Supervening Event Claim"); and

ii. promptly, and in any event within 25 Working Days of becoming aware of such occurrence, submit to the Enterprises a claim in the form provided in Schedule 21 (*Forms of Supervening Event Submissions*) (a "Detailed Supervening Event Claim"),

provided that, for purposes of determining when Developer is required to submit any notice or claim under this Section 15.1.2, Developer shall be deemed to be aware of any Supervening Event on the date of its occurrence to the extent Developer failed to comply with its obligations under Section 15.1.1.

15.1.3. Developer may:

a. satisfy its obligation under Section 15.1.2.a by instead initially submitting either a Preliminary Supervening Event Claim or a Detailed Supervening Event Claim; and

b. satisfy its obligation under Section 15.1.2.b.i by instead submitting a Detailed Supervening Event Claim,

in each case promptly and in any event no later than the relevant deadline that would have otherwise applied under, respectively, Section 15.1.2.a or Section 15.1.2.b.i.

15.1.4. After Developer submits any notice or claim to the Enterprises under Section 15.1.2 or 15.1.3, Developer shall promptly:

a. notify the Enterprises if at any time it becomes aware of any further material information relating to the Supervening Event, to the extent that such information is new or renders information previously submitted materially inaccurate or misleading; and

b. following the Enterprises' reasonable request, submit to the Enterprises additional information related to the relevant Supervening Event.

15.2. Limitations on Supervening Event Claims

15.2.1. Failure to provide timely notice

If Developer fails to comply with its obligations under Sections 15.1.2, 15.1.3 or 15.1.4, as applicable, compliance with which is a condition precedent to Developer being granted any extension of time, compensation or other relief pursuant to Section 15, then it shall be deemed to have irrevocably and forever waived and released any and all claim or right with respect to such event under this Section 15 or otherwise.

15.2.2. Duty to mitigate

a. Without modifying its other obligations under this Agreement, Developer shall use Reasonable Efforts to anticipate and mitigate the effects of any Supervening Event, including by re-sequencing, reallocating or redeploying its forces to other parts of the Work.

b. Developer shall not be entitled to any extension of time, compensation or other relief pursuant to Section 15 to the extent the claim for such extension of time, compensation or other relief could have been avoided by its compliance with Section 15.2.2.a.

15.2.3. Events affecting Financial Close

Developer shall not be entitled to claim any extension of time, compensation or other relief pursuant to Section 15.3.1 to the extent such claim would be for:

a. an extension of the Financial Close Deadline; and/or

b. any relief from and/or compensation in connection with Developer's performance of its obligations with respect to Financial Close pursuant to Sections 27.1 and 27.2 and Schedule 1 (*Financial Close*).

15.3. Resolution

15.3.1. If Developer has complied with its obligations under Section 15.1 and, through the submission of a Detailed Supervening Event Claim, has demonstrated, to the satisfaction of the Enterprises, that:

a. the Supervening Event occurred; and

b. Developer has a right:

i. in the case of either a Relief Event or a Compensation Event, to the extension of time and/or relief; and

ii. in the case of a Compensation Event only, to the compensation,

in the case of each of i. and ii., such relief and/or compensation as determined pursuant to this Section 15,

then, subject to Section 15.2, and in each case as reasonably determined by the Enterprises unless otherwise agreed or determined pursuant to Section 15.3.2:

c. in the case of any Supervening Event, Developer shall be relieved from the performance of its obligations under this Agreement to the extent, and only to the extent, that Developer's inability to perform such obligations is due solely and directly to, and limited to the duration of the direct effects of, such Supervening Event, provided that Developer shall not be excused from timely compliance with any obligation to make a payment pursuant to this Agreement due to the occurrence of any Supervening Event;

d. in the case of any Supervening Event:

i. to the extent that any Noncompliance Event is directly attributable to the occurrence of such Supervening Event, subject to Section 15.3.1.c, no Noncompliance Points shall accrue in respect of such Noncompliance Event; and

ii. to the extent that any Closure is directly attributable to the occurrence of such Supervening Event, such Closure shall be an Excused Closure, but only to the extent that paragraphs e. and f. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*) are satisfied;

e. in the case of any Supervening Event, if it has been agreed or determined that:

i. the Supervening Event affected the Critical Path, after taking into account any available Float pursuant to Section 9.2.3.a; and

ii. the effect on the Critical Path:

A. could not have been avoided by Developer's compliance with Section 15.2.1; and

B. does not reflect a concurrent unrelated delay for which Developer is responsible,

then:

iii. if such Supervening Event occurred prior to the Baseline Substantial Completion Date, then the Baseline Substantial Completion Date shall be extended;

iv. if such Supervening Event occurred after the Baseline Substantial Completion Date but prior to the Substantial Completion Date, then the Longstop Date shall be extended; or

v. if such Supervening Event occurred after the Substantial Completion Date but prior to the Final Acceptance Date, then the Final Acceptance Deadline shall be extended,

in each case by the number of Calendar Days of delay by which it was agreed or determined that the Critical Path was delayed solely as a result of the occurrence of such Supervening Event;

f. in the case of any Supervening Event that occurs during the Operating Period, the Enterprises shall be entitled to deduct from any Performance Payment otherwise payable pursuant to Schedule 6 (*Performance Mechanism*):

i. Developer's avoidable costs of Work not being performed as a result of the occurrence of such Supervening Event; and

ii. the amount that Developer is or should be entitled to recover under any "business interruption" coverage under the Available Insurance as a result of the occurrence of such Supervening Event; and

g. in the case of a Compensation Event only, the Enterprises shall, subject to Section 15.7, compensate Developer for any Change in Costs pursuant to Sections 15.4, 15.5 and 15.6, as applicable, but without double-counting any Financing Costs that may be payable or have been paid pursuant to any of such Sections,

15.3.2. Upon agreement (in whole or, pending resolution of a Dispute, in part) between the Parties (or, as applicable, upon determination pursuant to the Dispute Resolution Procedures) as to the extension of time, relief and/or compensation to which Developer is entitled in respect of any Supervening Event as determined pursuant to Section 15.3.1, the Parties shall execute a written memorandum in a form to be prepared by the Enterprises setting out the details of such agreement (or, as applicable, determination).

15.4. Payment of Change in Costs

Subject to this Section 15, the Enterprises shall pay to Developer all documented Change in Costs actually incurred by it as a direct result of a Compensation Event through one, or any combination of more than one, of the following methods as determined in the Enterprises' discretion:

a. as a lump sum payment for work already performed (or, in the Enterprises' discretion, as a series of progress payments for payment of work as it is performed) within 45 Calendar Days of Developer's written demand for such payment;

b. as periodic deferred payments over the Term for work already performed within 45 Calendar Days of Developer's written demand for such payment (provided that at any time after electing such payment method, the Enterprises may choose to accelerate compensation through a (or a series of) lump sum payment(s) of the present value as of the date of payment of the remaining compensation); and/or

c. as an adjustment to the "Base CPP" and/or "Base OMRP" set out in Section 2(f) of Part 2 of Schedule 6 (*Performance Mechanism*), which adjustment will leave Developer in a No Better and No Worse position (such adjustment together with any deferred payments to be made under Section 15.4.b, "Deferred Compensation").

15.5. Financing

15.5.1. If, pursuant to Section 15.4, the Enterprises elect to compensate Developer through Deferred Compensation, Developer shall use Reasonable Efforts to obtain:

a. funding from the Lenders, or other lenders if permitted by the Financing Documents; and/or

b. equity support from existing and potentially new Equity Members of Developer,

in either case:

c. if, and only if, and to the extent necessary; and

d. on terms Acceptable to the Enterprises,

in advance of receiving the Deferred Compensation payments from the Enterprises.

15.5.2. If, despite such efforts and any compensation that is or would be paid pursuant to Section 15.4, Developer is unable to obtain such funding and equity support (or the Enterprises do not Accept the terms under which Developer is able to obtain additional financing), then, notwithstanding its prior election, the Enterprises shall pay the required compensation pursuant to Section 15.4.a.

15.5.3. If and to the extent compensation pursuant to Section 15.4 is paid through Deferred Compensation, Developer shall be entitled to additional compensation as necessary to leave Developer in a No Better and No Worse position.

15.6. Financing Costs and Delayed Substantial Completion

15.6.1. To the extent that Substantial Completion has not occurred by the Baseline Substantial Completion Date or (following the Baseline Substantial Completion Date) Substantial Completion is further delayed, in either case, as a result of the occurrence of a Compensation Event, the Parties shall determine, pursuant to Section 15.3.1.e, the aggregate number of Calendar Days (the "Substantial Completion Delay Period") beyond the Baseline Substantial Completion Date that Substantial Completion will be delayed or, as applicable, further delayed as a direct result of the occurrence of such Compensation Event.

15.6.2. To the extent that any Financing Costs become due for payment or repayment by Developer during the Substantial Completion Delay Period, the Enterprises shall pay to Developer an amount equal to such Financing Costs, less the amount Developer is or should be entitled to recover under any "delay in startup" coverage under the Available Insurance as a result of the occurrence of any such Compensation Event, no later than the later of 45 Calendar Days after the determination referenced in Section 15.6.1 and five Working Days prior to the date that such Financing Costs become due for payment or repayment, provided that (and notwithstanding any agreement or determination pursuant to this Section 15.6 that the Enterprises are liable to pay such Financing Costs) in the case of any individual payment or repayment of Financing Costs Developer has notified the Enterprises in writing at least 45 Calendar Days prior to the date on which the Enterprises are otherwise required to pay under this Section 15.6.2.

15.6.3. No later than 30 Calendar Days after the Substantial Completion Date, the Parties shall determine pursuant to Section 28.2 (such determination being referred to in this Section 15.6 as the "Reconciliation"), the extent to which Developer was left in a position that was No Better and No Worse as a result of the Substantial Completion Delay Period caused by any one or more Compensation Events:

a. taking into account (without double-counting):

i. payments made by the Enterprises to Developer pursuant to Section 15.6.2;

ii. Financing Costs incurred by Developer solely as a result of the occurrence of any such Compensation Event but which were not previously taken into account in any payments made by the Enterprises to Developer pursuant to Section 15.6.2;

iii. Developer's avoidable costs of Work not being performed as a result of the occurrence of any such Compensation Event; and

iv. the amount Developer is or should be entitled to recover under any "delay in startup" coverage under the Available Insurance as a result of the occurrence of any such Compensation Event; and

b. assuming, without double counting, that all other Change in Costs have been or otherwise will be paid pursuant to Sections 15.4 and 15.5.

15.6.4. To the extent that the Reconciliation demonstrates that Developer was left in a worse position as determined pursuant to Section 28.2 notwithstanding the payments made to Developer by the Enterprises pursuant to Section 15.6.2, then at the Enterprises' discretion:

a. the Enterprises shall, within 45 Calendar Days of completion of the Reconciliation, make a lump sum payment to Developer; or

b. the "Base CPP" set out in Section 2(f) of Part 2 of Schedule 6 (*Performance Mechanism*) shall be adjusted pursuant to Section 15.4.c,

in either case in a manner that would result in Developer being left in a No Better and No Worse position.

15.6.5. To the extent that the Reconciliation demonstrates that Developer was left in a better position as determined pursuant to Section 28.2 as a result of the payments made to Developer by the Enterprises pursuant to Section 15.6.2, then at the Enterprises' discretion:

a. Developer shall make a lump sum payment to the Enterprises; or

b. the "Base CPP" set out in Section 2(f) of Part 2 of Schedule 6 (*Performance Mechanism*) shall be adjusted pursuant to Section 15.4.c,

in either case in a manner that would result in Developer being left in a No Better and No Worse position.

15.7. Compensation Exclusions

The Enterprises shall only compensate Developer for the Change in Costs and/or any Financing Costs (in each case, calculated net of any amount that Developer is or should be entitled to recover under any Available Insurance pursuant to Section 35.5) resulting from a Compensation Event pursuant to Sections 15.3.1.g, 15.4 and 15.6 if:

a. the aggregate amount of such Change in Costs and/or Financing Costs resulting from such Compensation Event is greater than $20,000 (indexed) (any such event, a "Compensable Event"); and

b. the aggregate amount of such Change in Costs and/or Financing Costs resulting from all Compensable Events in any given Contract Year is greater than $250,000 (indexed), in which case the Enterprises shall compensate Developer for the amount by which such aggregate Change in Costs and/or Financing Costs are greater than $250,000 (indexed).

15.8. Special Provisions for Force Majeure Events

15.8.1. Following the occurrence of a Force Majeure Event:

a. Developer, if an Affected Party with respect to such Force Majeure Event, shall promptly notify the Enterprises; and

b. the Enterprises, if an Affected Party with respect to such Force Majeure Event, shall use Reasonable Efforts to promptly notify Developer,

of the Force Majeure Event, including the date of its commencement, evidence of its effect on the obligations of the Affected Party and any action proposed to mitigate its effect.

15.8.2. Whether or not any notice has been given pursuant to Section 15.8.1:

a. Developer, if an Affected Party, shall comply with Sections 15.1 and 15.2.2.a with respect to the treatment of the relevant Force Majeure Event as a Relief Event pursuant to Section 15.3; and

b. the Enterprises, if an Affected Party, may require Developer to consult with them in good faith, and to use all Reasonable Efforts, to agree on appropriate terms to mitigate the effects of the relevant Force Majeure Event and facilitate the continued performance of this Agreement.

15.8.3. To the extent either of the Enterprises is an Affected Party, the Enterprises shall be relieved from the performance of their affected obligations under this Agreement (and shall not incur liability to Developer for losses or damages to the extent a Force Majeure Event occurs and either the Enterprises are prevented from carrying out its obligations) to the extent the Enterprises' inability to perform such obligations is due to, and limited to the duration of, such Force Majeure Event, provided that, notwithstanding the foregoing, the Enterprises shall not be excused from timely payment of any monetary obligations under this Agreement due to the occurrence of any Force Majeure Event.

PART E: KEY PERSONNEL, SUBCONTRACTORS AND WORKFORCE

16. PERSONNEL

16.1. Developer's Key Personnel Obligations

Subject to Section 16.2, Developer shall ensure that all Key Personnel are at all relevant times (as determined by reference to the periods set out in Schedule 27 (*Key Personnel*)):

a. seconded to or employed by such Person; and

b. occupying the role and performing the function of their position,

in each case as required by or set out in such Schedule.

16.2. Removal or Replacement of Key Personnel

16.2.1. Developer shall not remove and/or replace any of the Key Personnel without the Enterprises' prior Approval, provided that Developer may, as required by Law or pursuant to Good Industry Practice, suspend or limit the duties of any Key Personnel individual pending the Enterprises' Acceptance of such removal or replacement.

16.2.2. If for any reason Developer wishes to either remove and/or replace any Key Personnel, Developer shall promptly deliver a notice to the Enterprises for Acceptance, setting out the reason for such removal and/or replacement, together with the identity, expertise and experience of the proposed replacement, which expertise and experience shall be at least equivalent to those of the Key Personnel individual it is proposing to replace (and otherwise compliant with the requirements of Section 16.1), together with any such support information or evidence as the Enterprises may reasonably require in relation to such matters.

16.3. Developer's Personnel Qualifications

Developer shall ensure that all Work shall be performed by personnel who are careful, skilled, experienced and competent in their respective trades or professions, who are professionally qualified to perform the relevant part Work pursuant to this Agreement, and who shall assume professional responsibility for the accuracy and completeness of the relevant part Work prepared or checked by them.

16.4. Employee Compensation Requirements

16.4.1. Maintenance Employee wage rates and benefits

a. Developer shall, and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall, with respect to and for the benefit of any Maintenance Employees:

i. maintain rates of pay for such employees that are at least equal to the lower of:

A. the minimum per hour rate paid to CDOT's Transportation Maintenance I employees: Class Code D7D1TX (from time to time); or

B. $19.19[2] per hour (indexed); and

ii. maintain employer's contribution to the cost of the healthcare (medical insurance) and dental plans offered to such employees that are at least equal to the lower of:

A. the contribution offered by CDOT to CDOT's Transportation Maintenance I employees, Class Code D7D1TX (from time to time); and

B. the contributions set out in the following tables (indexed).

For Medical Insurance:	*Employee Only*	*Employee + Spouse*	*Employee + Child(ren)*	*Employee + Spouse + Child(ren)*
CDOT contribution	$465.61	$872.59	$866.78	$1,230.06

For Dental Insurance:	*Employee Only*	*Employee + Spouse*	*Employee + Child(ren)*	*Employee + Spouse + Child(ren)*
CDOT contribution	$25.92	$42.62	$46.44	$62.22

b. For purposes of Sections 16.4.1.a.i.A and 16.4.1.a.ii.A, the reference for determining the then current reference rate of pay and contribution shall be, respectively:

i. the "Compensation Plan" for the current State fiscal year, complied and published by the Colorado Division of Human Resources, or any successor plan or report; and

ii. the "Total Compensation Summary" for the current State fiscal year and applicable back up documentation for State of Colorado employees as published by the Colorado Division of Human Resources, or any successor summary or documentation.

16.4.2. Maintenance Employee wage rates and benefits

Developer shall, and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall, pursuant to Section 19 maintain and make available for review, inspection and audit all such Project Records as are necessary to document its compliance with Section 16.4.1.

17. SUBCONTRACTING REQUIREMENTS

17.1. Subcontracting Terms and Requirements

17.1.1. Each Subcontract, and any amendments or supplements thereto, shall comply with and, as applicable, incorporate the terms set out in Part A of Schedule 16 (*Mandatory Terms*).

17.1.2. On or prior to the Agreement Date, Developer shall enter into the Principal Subcontracts with the Principal Subcontractors identified in its Proposal on terms that shall be in compliance with this

[2] The Enterprises expect to update this with the then current figure, if different, in the final RFP.

Agreement. Developer may enter into replacements to any such Principal Subcontract, or any new Principal Subcontract, pursuant to this Section 17.

17.1.3. Developer shall not, without the prior Approval of the Enterprises:

a. enter into any Principal Subcontract, or any agreement replacing all or part of (or otherwise materially and adversely affecting the interpretation of) any Principal Subcontract;

b. amend any Principal Subcontract, other than to the extent necessary to reflect a corresponding amendment or Change under this Agreement;

c. terminate, or permit or suffer any termination of, any Principal Subcontract (in whole or in part, other than to the extent necessary to reflect a corresponding amendment or Change under this Agreement);

d. assign or transfer any of its, or permit or suffer any assignment or transfer by a Principal Subcontractor of any of such Principal Subcontractor's, rights and/or obligations under any Principal Subcontract (in whole or in part); or

e. in any material respect, otherwise fail to perform, depart from its obligations, fail to enforce or waive or allow to lapse any rights it may have (or procure that others in any material respect either fail to perform, depart from their obligations, fail to enforce or waive or allow to lapse any rights they may have) under any Principal Subcontract.

17.2. Self-Performance

Developer shall ensure that the Construction Contractor self-performs at least 30% of the value of the Construction Work as measured by the amounts payable under the terms of the Construction Contract with respect to such Construction Work (excluding, for certainty, any amounts payable with respect to O&M Work During Construction).

17.3. Subcontracting with Affiliates

a. Without limiting its obligations under Sections 17.1 and 17.2, Developer shall have the right to have Work directly or indirectly performed by Affiliates of itself or any of its Equity Members (including any Affiliate that may be a Principal Subcontractor or other Subcontractor identified in the Preferred Proposer's Proposal) only if the following conditions are satisfied:

i. the Affiliate shall be qualified, experienced and capable in the performance of such part of the Work assigned;

ii. Developer shall execute, or have a Subcontractor execute, a written Subcontract with the Affiliate;

iii. such Subcontract shall:

A. be on terms consistent with this Agreement and Good Industry Practice;

B. be on terms no less favorable to Developer (or, as applicable, its Subcontractor) than those that Developer (or such Subcontractor) could reasonably obtain in an arms' length, competitive transaction with an unaffiliated Subcontractor;

C. be in form and substance substantially similar to Subcontracts then being used by Developer or its Subcontractors, as applicable, for similar work or services with unaffiliated Subcontractors; and

D. set out the scope of work and services thereunder and all the pricing, terms and conditions in relation to such scope of work and services.

b. Developer shall make no payments to Affiliates for work or services in advance of provision of such work or services under the terms of a Subcontract that complies with Section 17.3.a, except for reasonable mobilization payments or other payments consistent with arm's length, competitive transactions of similar scope.

17.4. Relationship with Subcontractors

17.4.1. No Subcontract entered into by Developer (or by any of Developer's Subcontractors) shall impose any obligation or liability upon the Enterprises (or CDOT) to any Subcontractor or to any of such Subcontractor's officers or employees.

17.4.2. Pursuant to Section 8.2, the retention of Subcontractors by Developer will not relieve Developer of its obligations under this Agreement.

17.5. Prompt Payment of Subcontractors

17.5.1. Developer shall, and shall ensure that each of its Subcontractors and each of its respective Subcontractors shall, pay each of its and their Subcontractors that:

a. is satisfactorily performing under its Subcontract; and

b. is either:

i. a Disadvantaged Business Enterprise; or

ii. a Subcontractor performing under a Subcontract with an aggregate value equal to or less than $10,000,000 (indexed),

promptly, which for such purposes means:

c. at the end of each month, payment of partial payments of the total amount due under the Subcontract, provided that such payments shall, together with all prior such payments, be at least equal to 95% of the calculated value of the completed work at such time; and

d. in any event, payment no later than 30 Calendar Days following payment from the Enterprises to Developer of any Milestone Payments, Performance Payments or other payment part of which is required under the terms of the relevant Subcontract to be used to pay such Subcontractor; and

e. with respect to retainage, payment no later than 30 Calendar Days following such Subcontractor's completion of its Subcontract.

17.5.2. All payments made to a Subcontractor pursuant to Section 17.5.1 shall be made in compliance with 49 CFR § 26.29.

17.5.3. Developer shall, and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall, pay each of its and their Subcontractors no later than:

a. with respect to any payment by Developer to any of its Subcontractors, within 30 days following receipt of payment from the Enterprises pursuant to this Agreement to the extent such payment from the Enterprises, or part thereof, is required under the terms of the relevant Subcontract to be used to pay such Subcontractor; and

b. with respect to any payment from any Subcontractor to any other Subcontractor that would be ultimately funded by a payment from the Enterprises to Developer under this Agreement, within such period as is required in compliance with C.R.S. § 24-91-103(2).

PART F: PROJECT MANAGEMENT

18. DELEGATION OF AUTHORITY

18.1. Delegations, Transfers and Assignments by or Among Enterprises

18.1.1. While, for ease of reference, HPTE and BE are collectively referred to herein as the "Enterprises", either one of them may in their discretion act or perform for both of them in their capacity as "Enterprises" under this Agreement, and Developer shall accept such action or performance as discharging the relevant obligation(s) of both Enterprises, except:

a. where this Agreement expressly refers to BE acting as PABs Issuer, and not to an Enterprise or the Enterprises; and

b. as otherwise required pursuant to Law.

18.1.2. Subject to compliance with Law, either Enterprise may also in its discretion:

a. delegate, transfer or assign any right or obligation under this Agreement to CDOT; and

b. pursuant to Section 39.2, transfer or assign its interests, in whole or in part, in in the Project, the Right-of-Way, any Additional Right-of-Way, the Work or, its interests in, or rights or obligations under, this Agreement, any Contractor Bond, the Lenders Direct Agreement, any Principal Subcontractor Direct Agreement and/or the Insurance Policies.

18.2. Use of Representatives

18.2.1. Appointment of Representatives

a. Pursuant to this Section 18.2.1, Developer and the Enterprises shall each identify and maintain a person as its and their official representative (respectively, the "Developer's Representative" and the "Enterprise Representative" and, together, the "Representatives" and each a "Representative") with the functions and powers as set out in Section 18.2.2.

b. The Developer's Representative shall at all times be its "Project Manager", initially as identified in Schedule 27 (*Key Personnel*), subject to replacement pursuant to Section 16.2. The Enterprise Representative shall initially be their "Project Director" as notified to Developer on or prior to the Agreement Date, subject to replacement pursuant to Section 18.2.1.

c. From time to time:

i. the Enterprises may replace their Representative; and

ii. Developer and the Enterprises may each delegate all or part its or their Representative's responsibilities under this Agreement,

in either case by notice to the other Party containing:

iii. the name, title, mailing address, principal phone numbers, email address (or digital equivalent) and fax number (if any) of the replacement Representative or delegatee;

iv. in the case of partial delegations of authority, a schedule setting out the extent to which authority for managing any aspect of this Agreement has been delegated and to whom; and

v. in the case of time-limited replacements or delegations, the start and end date for such time-limited replacement or delegation.

18.2.2. Power and authority of Developer Representatives

Except as previously notified by Developer to the Enterprises before any relevant act or instruction occurs or is given:

a. the Enterprises shall be entitled to assume that Developer's Representative has, and Developer shall (subject to reasonable exceptions and limitations to be notified to the Enterprises) ensure that Developer's Representative shall have, full authority to act on behalf of Developer for all purposes of this Agreement; and

b. subject to any exceptions or limitations previously notified to them, the Enterprises and the Enterprise Representative shall be entitled to treat any act of Developer's Representative in connection with this Agreement as being expressly authorized by Developer and the Enterprises and the Enterprise Representative shall not be required to determine whether any express authority has in fact been given.

18.2.3. Power and authority of Enterprise Representative

Except as previously notified by the Enterprises to Developer before any relevant act or instruction occurs or is given:

a. Developer shall only be entitled to assume that the Enterprise Representative has the functions and powers of the Enterprises (collectively, and pursuant to this Agreement where necessary or permissible, individually) in relation to the Project that are identified in this Agreement as functions or powers to be carried out by the Enterprise Representative; and

b. Developer and Developer's Representative:

i. shall be entitled to treat any written action or instruction by the Enterprise Representative that is authorized by this Agreement as being expressly authorized by the Enterprises (collectively, and pursuant to this Agreement where necessary or permissible, individually) and Developer and Developer's Representative shall not be required to determine whether any express authority has in fact been given; and

ii. shall not be entitled to treat any other act or instruction by any other officer, employee or other Person engaged by the Enterprises or CDOT, unless otherwise expressly authorized pursuant to this Agreement, as being authorized by the Enterprises, and upon receiving any such presumptively unauthorized act or instruction from any Person, Developer shall promptly submit a written request to the Enterprises requesting clarification whether and to what extent authority has in fact been given to the relevant Person.

PART G: PUBLIC OVERSIGHT

19. RECORD KEEPING

19.1. Project Records

19.1.1. General obligation to maintain Project Records

Developer shall (and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall) at all times create and maintain full and complete records, books, documents, papers, databases, files and other documentation of information relating to the Project and, as applicable, Developer's performance of its obligations under this Agreement and the Principal Subcontracts and each Subcontractor's performance under the Subcontracts to which it is a party, including:

a. as required by Law, including CORA to the extent it is applicable to Project Records in the custody of Developer-Related Entities as a matter of Law;

b. pursuant to Good Industry Practice;

c. pursuant to GAAP, as applicable;

d. as otherwise required by the provisions of this Agreement other than this Section 19.1.1, including pursuant to Section 13 of Schedule 8 (*Project Administration*);

e. as required under the terms of any Financing Documents; and

f. maintenance of copies of:

i. all Principal Subcontracts (and all amendments and waivers thereto) and, with respect to each Subcontractor's records, of each Subcontract to which it is a party (and all amendments and waivers thereto); and

ii. all notices, correspondence, submissions, change, purchase or work orders, or other documents and materials expressly referenced as work product in this Agreement, any Principal Subcontract and, with respect to each Subcontractor's records, each Subcontract to which it is a party,

together, the "Project Records".

19.1.2. Standards for maintenance of Project Records

Developer shall (and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall):

a. create and maintain Project Records in the format or formats (hardcopy, analog, digital or otherwise) determined from time to time by reference to the requirements and standards set out in Sections 19.1.1.a through 19.1.1.f;

b. maintain originals or copies of all Project Records that are otherwise required to be maintained in a physical format at a location in the State; and

c. develop and maintain procedures to backup and secure all Project Records that, at a minimum, comply with Law and Good Industry Practice and, at the reasonable request of

the Enterprises, use Reasonable Efforts to develop and maintain procedures to backup and secure all Project Records that exceed such minimum standards.

19.1.3. Inspection of Project Records

Developer shall, without charge:

a. make all its Project Records available for inspection by the Enterprises, CDOT or any of their representatives or designees (each, an "Inspecting Party") pursuant to this Section 19.1.3;

b. make its Project Records available for inspection by the Inspecting Parties at its principal offices in the State, or at such other facilities as the Enterprises may reasonably require on behalf of themselves or any other Inspecting Party to the extent records are maintained at such other facilities:

i. during normal business hours (and, upon reasonable request, at times outside normal business hours); and

ii. upon reasonable notice, unless the Enterprises have a good faith suspicion of fraud in which case no prior notice shall be required;

c. allow any Inspecting Party to make extracts and take notes during any inspection and, upon request, furnish copies of Project Records to any Inspecting Party; and

d. subject to its obligations to comply with Section 19.1.2.c, and without limiting its obligations pursuant to Schedule 8 (*Project Administration*), prior to issuance of NTP2 Developer shall submit to the Enterprises for Acceptance, and have received Acceptance of, a written protocol with respect to making all Project Records maintained in digital formats available for real-time, "24/7" secure remote access by the Inspecting Parties to the extent reasonably practicable. Developer shall thereafter comply with such protocol.

19.1.4. Subcontractor Project Records

a. Developer shall ensure that each of its Subcontractors and each of their respective Subcontractors shall, either directly or through Developer and in either case without charge, make its Project Records available to the Inspecting Parties, for inspection on terms equivalent to those set out in Section 19.1.3.a to 19.1.3.c.

b. To the extent any Project Records are in the exclusive possession of a Subcontractor that fails to make such records available pursuant to Section 19.1.4.a, Developer shall notify the Enterprises of such occurrence, identify the Project Records that are unavailable, and describe what efforts Developer has made to secure compliance or otherwise obtain such Project Records.

19.1.5. Limitations on disclosure

Notwithstanding anything to the contrary contained in this Agreement:

a. Developer shall not be required to disclose, or to ensure the disclosure by any of its Subcontractors and/or of their respective Subcontractors of, any Project Records protected by attorney-client or other legal privilege under Law based upon an opinion of counsel reasonably satisfactory to the Enterprises unless such disclosure is otherwise compelled by Law; and

b. to the extent permitted by Law, the Parties agree that the Financial Model shall at all times be treated by the Parties as proprietary and confidential commercial non-public information which may only be reviewed by and accessed by the Enterprises pursuant to this Agreement and the Financial Model Escrow Agreement.

19.1.6. Retention of Project Records

a. Each individual Project Record shall be retained for a period of at least seven years after such Project Record is first generated, or for such longer period as may be required pursuant to Sections 19.1.1.a through 19.1.1.f or Section 19.1.6.b.

b. Notwithstanding Section 19.1.6.a, Developer shall (and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall) retain and make available pursuant to this Section 19.1 all Project Records:

i. that relate to Claim or Dispute until any later date that such matters are agreed or determined; and

ii. in existence on the last Calendar Day of the Term (or the equivalent under any Subcontract) until the later of the seventh anniversary of such day and any date as may be required pursuant to Sections 19.1.1.a through 19.1.1.f.

19.1.7. Survival of obligations

Developer's obligations under this Section 19.1 shall survive until the later of:

a. the seventh anniversary of the Expiry Date (or, if applicable, the Termination Date); and

b. with respect to the retention of any Project Record, such date as determined pursuant to Section 19.1.6.

19.2. Financial Statements

a. In addition to all Developer's other obligations to prepare and deliver reports and other materials under this Agreement, Developer shall provide the Enterprises with copies of the following:

i. its unaudited quarterly and annual accounts within 20 Working Days of the end of Developer's relevant fiscal period; and

ii. its audited annual accounts within 20 Working Days of the end of Developer's fiscal year,

each of which may be subject to redactions made in compliance with Section 20 and may be subsequently made available to the public pursuant to CORA.

20. COLORADO OPEN RECORDS ACT

20.1.1. Notwithstanding anything to the contrary contained in this Agreement, Developer acknowledges and agrees that this Agreement, except as provided for in Section 19.1.5, shall not be treated as CORA Exempt Materials and may be disclosed by the Enterprises without restriction.

20.1.2. Prior to issuance of NTP1, Developer shall submit to the Enterprises for Acceptance, and have received Acceptance of, a written protocol for the disclosure and, as applicable, exemption from disclosure, of Project Records in compliance with CORA and other Laws applicable to the disclosure of such Project Records. Developer shall thereafter comply with such protocol.

20.1.3. Neither the Enterprises, nor CDOT shall be responsible or liable to Developer or any other Person for the disclosure of any Project Records if the disclosure:

a. is required or permitted by Law;

b. is required by court order;

c. occurs through inadvertence or mistake;

d. is made to the FHWA or the US DOT; or

e. is compliant with the protocol Accepted pursuant to Section 20.1.2.

20.1.4. In the event the Enterprises or CDOT receives a CORA request for Project Records that are in the custody and control of Developer-Related Entities, Developer shall cooperate with the Enterprises, CDOT and, as applicable, the State's Attorney General's office, and shall cause all Subcontractors and each of their respective Subcontractors to cooperate, in responding to such request in a timely manner under CORA.

20.1.5. Developer shall be responsible for all costs associated with defending any request for disclosure of any Project Records claimed by Developer to be exempt from disclosure under CORA, whether such records are in the custody of Developer (or any other Developer-Related Entity), the Enterprises or CDOT. In connection with this obligation, Developer shall:

a. use Reasonable Efforts to assist the Enterprises (and to secure the assistance of the Enterprises by each of Developer's Subcontractors and of each of their Subcontractors) in such defense;

b. pursuant to Section 24.2, indemnify the Enterprises for any Losses incurred or suffered by them in such defense; and

c. at the request of the Enterprises or the State Attorney General's office, intervene in any such defense at its own cost and with its own counsel.

20.1.6. Developer shall not (and shall ensure that each of its Subcontractors and each of their respective Subcontractors shall not) disclose any Project Records to any Person, other than:

a. as expressly permitted by this Agreement;

b. as required by Law or a court order;

c. in compliance with the protocol Accepted pursuant to Section 20.1.2; or

d. with the Enterprises' prior Approval,

and, in each case, where such information relates to a member of the public, Developer shall not disclose or make use of any such information otherwise than for the purpose for which it was provided and then only in compliance with Law, unless Developer has obtained the prior written consent of such Person and of the Enterprises.

21. INSPECTIONS AND AUDITS

21.1. Site Inspections and Annual Survey and Audit Rights

21.1.1. Inspections of the Site

a. Subject to Section 21.1.1.b, the Enterprises, CDOT, the FHWA and their respective authorized agents, shall have an unrestricted right to enter the Site from time to time in order to:

i. inspect the state and progress of the Work and to monitor compliance by Developer with its obligations under this Agreement, including by conducting inspections, surveys, sampling, measurements, observations, testing and other reasonably necessary oversight activities;

ii. conduct routine, in-depth or any other type of inspection or other oversight activity in accordance with their standard practices; and/or

iii. any other inspection or oversight activity expressly contemplated by this Agreement,

provided that any such activities are conducted pursuant to Section 21.1.3.a.

b. In exercising their rights under this Section 21.1.1, the Enterprises shall at all times comply with all relevant site rules in relation to the Site.

21.1.2. Annual Survey and Audit Rights

a. Once in every Calendar Year, and at additional times if the Enterprises reasonably believe that Developer is in breach of its obligations under this Agreement, the Enterprises may carry out or cause the carrying out of:

i. a survey of the Project and the Work (or part of the Project and the Work) by a suitably qualified independent expert (not being an employee or consultant of either Enterprise or CDOT that has otherwise been materially involved in the Project (except for purposes of conducting a prior survey)); and

ii. an audit of Developer's records and its compliance with its obligations under this Agreement.

b. The Enterprises shall notify Developer in writing a minimum of 10 Working Days in advance of the date they wish to carry out a survey or audit described in Section 21.1.2.a, provided that no such prior notice shall be required if the Enterprises reasonably believe that Developer is in breach of its obligations under this Agreement. Unless a Developer Default has occurred and is continuing, the Enterprises shall consider in good faith any reasonable request by Developer for the survey or audit to be carried out on a different date if such request is made at least five Working Days prior to the notified date and Developer (acting reasonably) is able to demonstrate that carrying out the survey on the notified date would materially prejudice Developer's ability to perform its obligations or exercise its rights under this Agreement. The survey and audit described in Section 21.1.2.a may be conducted separately during any relevant calendar year.

21.1.3. Rules governing conduct of inspections, surveys and audits

a. When carrying out any inspection, survey or audit pursuant to Section 21.1.1 or Section 21.1.2, the Enterprises shall use Reasonable Efforts to minimize any unnecessary disruption to the Work and Developer's performance of its obligations under this Agreement.

b. Subject to Sections 21.1.3.c and 21.1.4.a.iii, as between the Enterprises and Developer, the cost of the inspection, survey or audit conducted pursuant to this Section 21.1.1 or Section 21.1.2 shall be borne by the Enterprises.

c. Developer shall, at its own cost and expense, use Reasonable Efforts to provide assistance to the Enterprises as required from time to time during the carrying out of any inspection, survey or audit conducted pursuant to this Section 21.

21.1.4. Findings of breach

a. If an inspection, survey or an audit conducted pursuant to Section 21.1.1 or Section 21.1.2 is conducted in response to a Developer breach or Developer Default, or subsequently demonstrates that Developer has not complied or is not complying with its obligations under this Agreement, including with respect to Project Records pursuant to Section 19.1, the Enterprises may, as applicable and in their discretion:

i. notify Developer of the condition which the Project and the Work (or any part of the Project and the Work) should be in to comply with Developer's obligations under this Agreement or, without altering Developer's obligations hereunder, of other steps the Enterprises believe should be taken with respect to Developer's obligations under this Agreement;

ii. specify a reasonable period within which Developer must carry out any rectification and/or maintenance work, or where rectification or maintenance work cannot rectify the non-compliance, to take reasonable steps to prevent the recurrence of such a non-compliance; and/or

iii. be entitled to be reimbursed by Developer for the cost and expense of the inspection, survey or audit and any administrative fees and expenses incurred by the Enterprises in relation to such inspection, survey or audit.

b. Notwithstanding any action by the Enterprises pursuant to Section 20, Developer shall promptly (or within such other period of time as is required or expressly permitted by Law and the provisions of this Agreement) rectify any non-compliance identified by any survey or audit conducted pursuant to this Section 20.

21.2. Right to Conduct Physically Intrusive Inspections

21.2.1. Without prejudice to the Enterprises' other rights under this Agreement, the Enterprises shall have the right, at any time prior to the Final Acceptance Date or prior to completion of any Renewal Work and, in either case, upon reasonable notice, to require Developer to permit physically intrusive inspections by the Enterprises of any part or parts of the Construction Work or Renewal Work, as applicable, including by opening up covered or sealed portions of the Work, when the Enterprises reasonably believe that such part or parts of the Construction Work or Renewal Work, as applicable, do not comply with the requirements of this Agreement. In carrying out any such inspection the Enterprises shall use Reasonable Efforts to minimize unnecessary disruption to the Work and Developer's performance of its obligations under this Agreement.

21.2.2. If, following the exercise by the Enterprises of their right pursuant to Section 21.2.1, such inspection shows that the relevant part or parts of the Construction Work or Renewal Work, as applicable, do comply with the requirements of this Agreement, such inspection shall be treated as a Compensation Event.

21.2.3. If, following the exercise by the Enterprises of their right pursuant to Section 21.2.1, the inspection shows that the relevant part or parts of the Construction Work or Renewal Work:

a. do not comply with the requirements of this Agreement, then Developer shall rectify such noncompliance at its own cost expense; or

b. comply with the requirements of this Agreement, and such compliance was previously documented in the Project Records properly maintained and made available to the Enterprises pursuant to Section 19.1 at or prior to the date on which a physically intrusive inspection began pursuant to Section 21.2.1, such inspection shall be treated as a Compensation Event

21.2.4. Without prejudice to the rights of the Enterprises pursuant to this Section 21.2, the Parties acknowledge that the exercise of such rights pursuant to this Section 21.2 shall not in any way affect the obligations of Developer under this Agreement except as expressly set out in this Section 21.2 or elsewhere in this Agreement.

21.3. Increased Oversight

21.3.1. The Enterprises may, in their discretion:

a. wherever there are material Defects in the Work or Developer has materially failed to comply with the Technical Requirements (other than with respect to any breach that constitutes a Noncompliance Event) which failure remains uncured; and/or

b. at any time when the Increased Oversight Threshold has been met or exceeded,

without prejudice to any other right or remedy available to them, and without limiting Developer's other obligations under this Agreement (including obligations to remedy Defects and to otherwise perform in accordance with the requirements set out in this Agreement), by notice to Developer:

c. require Developer to promptly prepare and submit for Approval a remedial plan to, as applicable:

i. remedy such Defects or failure and prevent its recurrence; or

ii. improve performance so as to address the causes of the Increased Oversight Threshold being met or exceeded,

and, following Approval of such plan, Developer shall be required to comply with such plan; and/or

d. increase the level of their monitoring of Developer relative to the prior standard of practice under this Agreement (including by maintaining compliance by Developer with the Approved remedial plan) prior to such Defect or failure, or to the Increased Oversight Threshold being met or exceeded, until such time as Developer shall have demonstrated to the reasonable satisfaction of the Enterprises that it is capable of performing and shall perform all its obligations under this Agreement.

21.3.2. If the Enterprises issues a notice pursuant to Section 21.3.1, Developer shall bear its own costs and expenses and pay to the Enterprises on demand all costs and expenses incurred by or on behalf of the Enterprises in relation to any increased level of monitoring.

PART H: PERFORMANCE MANAGEMENT

22. PERFORMANCE-BASED PAYMENT DEDUCTIONS AND PERSISTENT BREACH

22.1. Performance-based Payment Deductions

22.1.1. Pursuant to Section 3(b) of Schedule 5 (*Milestone Payments*) and Part 1 of Schedule 6 (*Performance Mechanism*), certain Construction Period performance related deductions shall be made from the Substantial Completion Milestone Payment.

22.1.2. Pursuant to Parts 2 and 3 of Schedule 6, certain Operating Period performance related deductions shall be made from each Performance Payment.

22.2. Persistent Breach by Developer

22.2.1. If a breach of this Agreement (other than any breach that constitutes a Noncompliance Event or results in the accrual of a Construction Closure Deduction or an Operating Period Closure Deduction) has:

a. continued for more than 14 continuous Calendar Days; or

b. occurred three or more times in any six month period,

then the Enterprises may serve a notice (an "Initial Warning Notice") on Developer:

c. specifying that it is an Initial Warning Notice;

d. giving reasonable details of the breach; and

e. stating that the relevant breach is a breach which, if it recurs frequently or continues, may result in a Developer Default for Persistent Breach,

provided that an Initial Warning Notice may not be served in respect of any incident of breach which has previously been the subject of a separate Initial Warning Notice or a Final Warning Notice.

22.2.2. If the breach specified in an Initial Warning Notice:

a. continues beyond 30 consecutive Calendar Days; or

b. recurs three or more times within the six month period after the date of service of the Initial Warning Notice,

then the Enterprises may serve another notice (a "Final Warning Notice") on Developer:

c. specifying that it is a Final Warning Notice;

d. stating that the breach specified has been the subject of an Initial Warning Notice; and

e. stating that:

i. the continuation of such breach for more than an additional 14 consecutive Calendar Days; or

ii. the recurrence of such breach two or more times within the six month period after the date of service of the Final Warning Notice,

shall constitute a "Persistent Breach", which itself shall constitute a Developer Default pursuant to Section 32.1.1.

23. SAFETY COMPLIANCE, SUSPENSION OF THE WORK AND PUBLIC SECTOR RIGHTS TO INTERVENE

23.1. Safety Compliance

23.1.1. Subject to their obligations under Section 23.1.2, the Enterprises may, in their discretion, issue Safety Compliance Orders to Developer from time to time.

23.1.2. Except in the case of an Emergency, the Enterprises shall use Reasonable Efforts:

a. to promptly inform Developer of any circumstance or information relating to the Project which, in the Enterprises' reasonable judgment, is likely to result in the issuance of a Safety Compliance Order; and

b. consult with Developer prior to issuing a Safety Compliance Order.

23.1.3. Developer shall promptly and expeditiously implement each Safety Compliance Order that the Enterprises issue pursuant to Section 23.1.1, including the use of Reasonable Efforts to overcome any inability to comply with any Safety Compliance Order caused by a Supervening Event.

23.2. Refusal of Access

The Enterprises reserve the right to refuse (or, alternatively, authorize the Department to refuse) access to the Right-of-Way by any Person:

a. if the Enterprises reasonably believe that:

i. the presence or activities of such Person on the Right-of-Way or any Additional Right-of-Way represents a material risk to the health or safety of any person, the Environment, the community or property;

ii. such Person is under the influence of alcohol or drugs; or

iii. such Person is acting or threatening to act in a violent, harassing, discriminatory or illegal manner, or such Person previously acted in such a manner; or

b. who previously committed any of the conduct described under Section 23.2.a while accessing any part of the Site.

23.3. Suspension of Construction Work

23.3.1. The Enterprises shall at all times have the right and authority to suspend, in whole or in part, the Work by written order to Developer. Any such order shall state the Enterprises' reasons for the required suspension of the Work.

23.3.2. Except where any suspension of the Work by the Enterprises pursuant to Section 23.3.1 is made in response to:

a. any failure by Developer to comply with any Law, Governmental Approval or Permit; or

b. the existence of conditions unsafe for workers, other Project personnel or the general public, including failures to comply with Project Standards related to safety or to comply with any Safety Compliance Order,

any such suspension order shall constitute a Compensation Event.

23.4. Self-Help

23.4.1. Self-help rights

Without limiting any other rights of the Enterprises under this Agreement, if the Enterprises reasonably believe that they need to take action in connection with the Project or the Work as a result of:

a. an Emergency having occurred and being continuing;

b. any Developer Default having occurred and not having been cured within any relevant Developer Default Cure Period;

c. Developer having failed to comply with its obligations pursuant to Section 23.1.3 with respect to any Safety Compliance Order; and/or

d. being necessary to discharge a constitutional or statutory duty or a duty imposed on the Enterprises, CDOT or the State by any Law, or to facilitate any such discharge by the Enterprises, CDOT or the State,

then the Enterprises shall be entitled to take action pursuant to Sections 23.4.2 and 23.4.3.

23.4.2. Notice of election to exercise self-help rights

Except in the case of an Emergency or a Developer Default, in which case the Enterprises shall only be obliged to use Reasonable Efforts to comply with their obligations under this Section 23.4.2, if the Enterprises wish to take action pursuant to Section 23.4.1 they shall notify Developer a reasonable time prior to taking such action, which notice may or may not include the following:

a. a description of any action that the Enterprises reasonably believe is necessary for them to take;

b. the reason for such action;

c. the date the Enterprises intend to commence such action;

d. the time period Developer has (if any) to take action before the Enterprises will commence such action;

e. the time period which the Enterprises believe will be necessary for such action; and

f. to the extent practicable, the effect on Developer and its obligation to perform the Work during the period such action is being undertaken.

23.4.3. Required actions

a. Following service of a notice by the Enterprises pursuant to Section 23.4.2 and expiration of any time within which Developer is permitted to take action pursuant to Section 23.4.2.d before the Enterprises will take action pursuant to Section 23.4.1, the Enterprises shall take such action as notified under Section 23.4.2 (or, in the case of an Emergency, as they may otherwise determine in their discretion) and any consequential additional action as they reasonably believe is necessary (together, the "Required Action"), and Developer shall use Reasonable Efforts to give all reasonably necessary assistance to the Enterprises while they are taking the Required Action.

b. Except in the case of an Emergency or a Developer Default, in which case the Enterprises shall only be obliged to use Reasonable Efforts to comply with their obligations under this Section 23.4.3.b, the Enterprises shall provide Developer with prompt notice of completion of the Required Action.

23.4.4. Reimbursement of Enterprises' costs and expenses

If the Enterprises take any Required Action, any costs and expenses of the Enterprises incurred in taking, or as a result of taking, such action shall be payable on demand by Developer to the Enterprises.

PART I: INDEMNIFICATION AND INSURANCE

24. INDEMNIFICATION

24.1. No Obligation to Indemnify Developer

Neither the Enterprises, nor CDOT, have any obligation to indemnify Developer.

24.2. Developer Indemnity

Subject to Section 24.3 and Sections 35.2 through 35.6, Developer shall, to the fullest extent permitted by Law, release, protect, defend, indemnify and hold harmless each Enterprise, CDOT and the State (the "Principal Indemnified Parties") and each of their respective officers, directors, agents and employees (each of the Principal Indemnified Parties and each such Person, an "Indemnified Party" and, collectively, the "Indemnified Parties") from and against any and all Claims and/or Losses arising from, or as a consequence of, the performance, non-performance or breach by Developer of any of its obligations under this Agreement, including any suffered or incurred in respect of:

a. death or personal injury;

b. loss of or damage to any Indemnified Party's property (whether personal or real), equipment or facilities, regardless of whether such property, equipment or facilities are owned, leased or otherwise held by such Indemnified Party, including loss of use thereof;

c. Claims asserted and/or Losses suffered by any third party, for which purposes "third party" shall include any officer, director, agent or employee who is an Indemnified Party and who asserts a Claim that is:

   i. against one or more of the Principal Indemnified Parties;

   ii. within the scope of the indemnities set out in this Section 24.2; and

   iii. not covered by the worker compensation program of the Principal Indemnified Party against which the Claim is asserted;

d. any claim against the Enterprises or CDOT by a counterparty to a Third Party Agreement as a result of any breach by CDOT or the Enterprises of a Third Party Agreement to the extent such breach was caused by an act or omission of Developer or any Developer-Related Entity;

e. any violation of Law, including any Federal or state securities Law or similar, or any Environmental Law, by any Developer-Related Entity; or

f. the authorization, issuance, sale, trading, redemption or servicing of the PABs or any other bonds issued to finance the Project, or Developer's failure to comply with any requirement necessary to preserve the tax exempt status of interest paid on the PABs or other tax exempt bonds.

24.3. Exclusions from Developer Indemnity

Developer's indemnification obligation under Section 24.2 shall not extend to any Loss or Claim of an Indemnified Party to the extent that such Loss or Claim was caused by:

a. a Supervening Event;

b. the fault, fraud, willful misconduct, criminal conduct, recklessness, bad faith or gross negligence of such Indemnified Party;

c. unexcused breach by the Enterprises of any of their obligations under this Agreement; or

d. such Indemnified Party's violation of any Laws.

24.4. Claims by Employees

Developer's indemnification obligation under Section 24.2 in relation to Losses and/or Claims against an Indemnified Party by an employee of Developer, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, shall not be limited by any limitation on the amount or type of damages, compensation or benefits payable by or for Developer or a Subcontractor under workers' compensation, disability benefit or other employee benefits laws.

24.5. Indemnification Process

a. If any of the Indemnified Parties receives notice of a Claim or otherwise has actual knowledge of a Claim that it believes is within the scope of the indemnities under Section 24.2, the Enterprises shall as soon as practicable after receipt of the Claim:

i. provide Developer with notice of the Claim; and

ii. send to Developer a copy of all written materials the Enterprises have received asserting such Claim,

provided, however, that any failure to give such notice will not constitute a waiver of any rights of the Enterprises except to the extent that the rights of Developer are actually prejudiced thereby.

b. Each Indemnified Party shall be entitled to appoint counsel of its choice to represent such Indemnified Party in any action for which indemnification is sought pursuant to this Section 24.5 with Developer being responsible for all fees and expenses related to each counsel representing any Indemnified Party.

c. Developer will not be liable for any settlement or compromise by an affected Indemnified Party of a Claim except with Developer's prior written consent, which consent shall not be unreasonably withheld, or except where the settlement or compromise is approved by an applicable court and such court approval has become final and non-appealable.

25. INSURANCE

[*Customary insurance policy requirements and provisions for a project of this kind, including protections against uninsurable risks, unavailability of certain terms, and fluctuations in costs against benchmarked costs, to be included in a subsequent Addendum.*]

PART J: EQUITY AND PROJECT DEBT

26. EQUITY REQUIREMENTS

26.1. Equity Contribution Requirements

26.1.1. Subject to Section 26.1.2, on and from the Financial Close Date through and including the Substantial Completion Date, Developer shall, at all times, have and maintain Committed Investments equal to or greater than 10% of the amount equal to the aggregate of the then Committed Investment plus the total principal amount of the then outstanding Long Term Project Debt:

26.1.2. The minimum amount of Committed Investments required under Section 26.1.1 is subject to reduction only:

a. with the Approval of the Enterprises; or

b. with the Acceptance of the Enterprises in the event that the amount of Committed Investments is required to be reduced below such percentage:

i. as part of a workout of a breach or default under the Financing Documents that were entered into in connection with Financial Close; or

ii. as a result of Developer incurring additional Project Debt pursuant to a Rescue Refinancing.

26.2. Equity Transfer and Change of Control Restrictions

26.2.1. A Developer Default shall occur if an Equity Transfer is effected:

a. during the Restricted Transfer Period, other than if such Equity Transfer is a Permitted Equity Transfer;

b. after the Restricted Transfer Period, if such Equity Transfer results in a Change of Control that has not been consented to by the Enterprises pursuant to Section 26.2.2; and

c. at any time (other than as a Permitted Equity Transfer under paragraph a. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*)), to a Person that at the time of the proposed transfer is disqualified, suspended or debarred or subject to a proceeding to suspend or debar from bidding, proposing or contracting with any Governmental Authority.

26.2.2. After the Restricted Transfer Period, any Equity Transfer that results in a Change of Control shall require the consent of the Enterprises, provided that such consent may be withheld or made subject to the condition of the provision of reasonable additional security or other reasonable arrangements if (and only if) the Enterprises determine, acting reasonably, that:

a. the proposed transaction or transactions is or are prohibited by Law or otherwise contrary to public policy; or

b. after the occurrence of such Change of Control Developer's ability to perform its obligations under this Agreement would be materially diminished, which determination may be based upon, or take into account in addition to other factors that the Enterprises may reasonably determine are relevant, the financial strength, integrity, past performance

and relevant experience of the proposed transferee(s) relative to the proposed transferor(s) and the then current performance requirements under this Agreement.

26.2.3. Developer shall use Reasonable Efforts to provide the Enterprises with at least 30 Calendar Days' prior notice of any Equity Transfer.

26.2.4. Any Equity Transfer made or purportedly made in violation of the restrictions set out in Sections 26.2.1 or 26.2.2 shall be null and void.

26.2.5. Developer agrees to reimburse the Enterprises for all costs and expenses (including fees and expenses of legal counsel) incurred by the Enterprises in connection with its review of any Equity Transfer.

27. DEBT FINANCING

27.1. Developer Responsibilities for Financing

27.1.1. Developer is solely responsible for obtaining and repaying all financing necessary for the Work and the Project, without recourse to the Enterprises except as expressly permitted or specified in this Agreement. Subject to Schedule 1 (*Financial Close*), Developer exclusively bears the risk of any changes in the interest rate, credit spreads, payment provisions, collateral requirements, financing charges, breakage charges or other terms of any of its financing commitments.

27.1.2. If Developer seeks to utilize PABs or a TIFIA Loan to finance the Work and the Project, then Developer is responsible for obtaining necessary approvals, complying with all applicable Federal, State and local requirements and achieving Financial Close, in each case subject to Schedule 1 (*Financial Close*).

27.2. Mandatory Terms of Financing Documents

Each Financing Document, including any amendments or supplements thereto, shall comply with and, as required, incorporate the terms set out in Part B of Schedule 16 (*Mandatory Terms*).

27.3. Limited Permission to Grant Security

27.3.1. Developer may grant security interests in, or assign its interest in, and its rights and obligations under, this Agreement, the Subcontracts, any Contractor Bonds and the Insurance Policies (but not greater than the entirety of such interest, rights and obligations, and excluding the Handback Reserve Account) to Lenders exclusively for purposes of securing the Project Debt, subject to the terms and conditions contained in this Agreement.

27.3.2. Developer is strictly prohibited from mortgaging, pledging or encumbering, or creating a lien, charge or security interest on or against, its interest in, and its rights and obligations under, this Agreement, the Subcontracts, any Contractor Bonds and the Insurance Policies or any portion thereof, to secure any indebtedness of any Person other than:

a. itself;

b. any special purpose entity that owns Developer but has no other assets and has purposes and powers limited to the Project and the Work;

c. a special purpose entity subsidiary owned by either Developer or by an entity described in Section 27.3.2.b above; or

d. the PABs Issuer,

and no Security Document or other instrument purporting to do the same shall extend to or affect the right, title and interest of the Enterprises in the Project or the Enterprises' rights or interests under this Agreement.

27.3.3. Notwithstanding the foreclosure or other enforcement of any security interest created by a Security Document, Developer shall remain liable to Enterprises for the payment of all sums owing to the Enterprises under this Agreement and the performance and observance of all of Developer's obligations under this Agreement.

27.4. Limitations on Enterprise Involvement in and Liability for any Financing

27.4.1. At Developer's written request, the Enterprises shall use Reasonable Efforts in order to assist Developer's efforts to achieve Financial Close with a TIFIA Loan and PABs, provided that, subject to Schedule 1 (*Financial Close*), the Enterprises shall not bear any risk for the failure to obtain funding from these potential sources, and such failure, if any, shall not diminish Developer's obligations under this Agreement.

27.4.2. None of the Enterprises, CDOT or any other Governmental Authority, other than the PABs Issuer to the extent of its obligations in relation to the PABs issued by it, shall:

a. Without prejudice to the Enterprises' obligations pursuant to Section 15.6, have any liability whatsoever for payment of any Project Debt, or of any other obligations issued or incurred by any Person in connection with this Agreement or the Project, or any interest accrued thereon or any other sum secured by or accruing under any Financing Document; or

b. join in, execute or guarantee any note or other evidence of indebtedness or any other obligation incurred in connection with this Agreement, the Project or under any Financing Document.

27.4.3. Any review or comment by the Enterprises of any Financing Document is not:

a. a guarantee or endorsement of the Project Debt or any other obligations issued or incurred by any Person in connection with this Agreement or the Project; or

b. a representation, warranty or other assurance as to the ability of any Person to perform its obligations with respect to the Project Debt or with respect to any other obligations of such Person in connection with this Agreement or the Project.

27.4.4. Except:

a. in the case of default by the PABs Issuer of its express obligations set out in a Financing Document to which it is a party; and

b. in the case of a breach by the Enterprises of their express obligations to Lenders set out in the Lenders Direct Agreement,

the Enterprises shall not have any obligation to any Lender pursuant to this Agreement, and no Lender is entitled to seek any damages or other amounts from the Enterprises (and, in the case of an event specified in Section 27.4.4.a, then only from BE in its capacity as PABs Issuer), whether for Project Debt or any other amount. For certainty, the foregoing does not affect Enterprises' liability to Developer under Section 33 and Schedule 7 (*Compensation on Termination*) of this Agreement for the payment of any Termination Amount.

28. FINANCIAL MODEL

28.1. General

28.1.1. Whenever a Relevant Event occurs (except as otherwise provided in this Agreement or where the Parties mutually agree otherwise), the financial consequences of such event shall be determined pursuant to this Section 28.

28.1.2. Where, for the purposes of this Section 28, the Financial Model is to be used to make calculations related to, and/or to be adjusted by reference to, a Relevant Event, this shall be carried out by Developer, in consultation with the Enterprises, to reflect the impact of the Relevant Event in respect of which such calculations and/or adjustment is being undertaken.

28.1.3. In calculating the Change in Costs and in assessing other adjustments to be made to the Financial Model arising from a Relevant Event, Developer shall not be entitled to take into account the financial impact up to or after the date of the Relevant Event of those risks which Developer expressly bears under the terms of this Agreement, including (to the extent so expressly borne by Developer under this Agreement) changes in taxation rates, inflation and the impact of any deductions made by the Enterprises pursuant to Schedules 4 (*Payment*), 5 (*Milestone Payments*) and 6 (*Performance Mechanism*).

28.2. No Better and No Worse

Any reference in this Agreement to "No Better and No Worse" or to leaving Developer in a "No Better and No Worse position" shall be construed by reference to Developer's:

a. rights, duties and liabilities under or arising pursuant to the performance of this Agreement, the Financing Documents and the Principal Subcontracts; and

b. ability to perform its obligations and exercise its rights under this Agreement, the Financing Documents and the Principal Subcontracts,

so as to ensure that:

c. Developer is left in a position which is financially no better and no worse in relation to the Key Ratios and the Equity IRR which position shall be ascertained by determining through an adjustment to the Financial Model made pursuant to Sections 28.3 and 28.4 the adjustment or credit to the payments between the Parties hereunder required to maintain Developer in the financial position it would have been in under the version of the Financial Model applicable immediately prior to the relevant adjustment; and

d. the ability of Developer to comply with this Agreement is not adversely affected or improved as a consequence of the Relevant Event.

28.3. Amendments to Logic and/or Formulae

28.3.1. Where it is necessary to amend the logic or formulae incorporated in the Financial Model to permit calculations and/or adjustments to be made as required by this Section 28, such amendments shall be made to the extent necessary.

28.3.2. If any amendment is to be made to the logic or formulae incorporated in the Financial Model pursuant to Section 28.3.1, the Financial Model shall first be run immediately prior to the making of any such amendment to ensure that the Key Ratios from the Financial Model are maintained at levels that are neither lower nor higher than the Key Ratios existing immediately after making

such amendment, and the difference in the Equity IRR after and immediately prior to making such amendment does not differ by more than one basis point (being 0.01%).

28.4. Financial Model Audits and/or Accuracy

28.4.1. In connection with any adjustments made to the Financial Model, including amendments to the logic or formulae incorporated in the Financial Model as contemplated by Section 28.3, and as a condition to any Approval pursuant to Section 28.6, Developer shall (at its own cost) deliver to the Enterprises an audit of such amended version of the Financial Model from an independent audit firm that is unaffiliated with Developer, is otherwise free of any conflict of interest and has a nationally recognized reputation.

28.4.2. Developer shall bear the entire risk of any errors in or omissions from the Financial Model and shall not be entitled to any compensation or other relief from the Enterprises in relation to any Loss or damage that it suffers as a result of any such error or omission.

28.5. Copies of the Revised Financial Model

Following any adjustment or other revision to the Financial Model under the provisions of this Section 28 or pursuant to Section 29, Developer shall promptly deliver a copy of the revised Financial Model to the Escrow Agent pursuant to the terms of the Financial Model Escrow Agreement in the same form as the versions delivered pursuant to Schedule 1 (*Financial Close*) prior to Financial Close.

28.6. Replacement of Financial Model

Any Financial Model produced following adjustments pursuant to this Section 28 shall, when it is Approved by the Enterprises, become the Financial Model for the purposes of this Agreement until any further amendment pursuant to Section 28 or 29 of this Agreement.

28.7. Financial Model License

a. Developer grants to the Enterprises a license to use the Financial Model commencing from its delivery pursuant to this Agreement to end of the Term or, if later, the date of full settlement of all mutual claims arising out of this Agreement that the Parties may have against each other if such a date occurs after the end of the Term, for any purpose in connection with this Agreement and/or the Project.

b. The license granted pursuant to Section 28.7.a shall not be transferable or assignable by the Enterprises except to CDOT or to any Person to whom this Agreement may be transferred in accordance with Section 39.2 and then only for purposes in connection with this Agreement and/or the Project.

29. REFINANCINGS

29.1. Enterprises' Approval, and Sharing in the Gains of Qualifying Refinancings

29.1.1. Developer shall not implement any Qualifying Refinancing without the prior Approval of the Enterprises

29.1.2. Following the completion by Developer of any Enterprise approved Qualifying Refinancing, the Enterprises shall be entitled to receive a 50% share of any Refinancing Gain arising therefrom, provided that the Enterprises shall not withhold or delay their Approval to a Qualifying Refinancing in order to obtain greater than a 50% share of the Refinancing Gain.

29.2. Developer Details

29.2.1. Developer shall notify Enterprises of any Qualifying Refinancing at least 30 Working Days (or 15 Working Days, in case of a Rescue Refinancing) in advance of the date that is proposed that such Qualifying Refinancing becomes effective.

29.2.2. The notice to be provided by Developer referred to in Section 29.2.1 shall include details of any changes to Developer's obligations to the Lenders, details of the anticipated Refinancing Gain and details of changes or replacements to the Financing Documents, and shall include a copy of the proposed revised Financial Model relating to the proposed Refinancing (if any) and the basis for the assumptions used in the proposed Financial Model.

29.2.3. No later than 10 Working Days (or five Working Days, in the case of a Rescue Refinancing) after delivery of the notice by Developer to the Enterprises pursuant to Section 29.2.1, the Enterprises shall notify Developer as to how Enterprises shall elect to receive its share of the Refinancing Gain pursuant to Section 29.3. No later than 10 Working Days (or five Working Days, in the case of a Rescue Refinancing) after delivery of such notice to Developer, Developer shall deliver to the Enterprises a detailed update to its original notice referred to in Section 29.2.1 reflecting any adjustments to the proposed revised Financial Model necessary to account of the Enterprises' election. With the Enterprises' Approval, such revised Financial Model shall become the Financial Model for purposes of this Agreement until any further amendment pursuant to Section 28 or 29 of this Agreement.

29.2.4. The Enterprises shall (before, during and at any time after any Refinancing) have unrestricted rights of audit over any Financial Model and documentation (including any aspect of the calculation of the Refinancing Gain) used in connection with that Refinancing, whether or not the Refinancing is a Qualifying Refinancing.

29.3. Receipt of Enterprises' Share

The Enterprises shall have the right to elect to receive its share of any Refinancing Gain described in Section 29.1.2 as either:

a. to the extent Developer receives a lump sum payment as a result of the Qualifying Refinancing, a lump sum payment (not to exceed 50% of such lump sum payment received by Developer), to be paid promptly and in any event no later than five Working Days following the relevant Distribution;

b. a reduction in the Performance Payment over the remainder of the Term in a manner to be determined by the Enterprises provided that Developer is left in a No Better and No Worse position; or

c. a combination of a. and b.

29.4. Costs

The Refinancing Gain shall be calculated after taking into account the reasonable and proper professional costs that each Party directly incurs in relation to the Qualifying Refinancing and on the basis that all reasonable and proper professional costs incurred by the Enterprises shall be paid to the Enterprises by Developer no later than 20 Working Days after any Qualifying Refinancing.

29.5. Notifiable Refinancings

Without prejudice to the other provisions of this Section 29, Developer shall notify the Enterprises of all Notifiable Refinancings on becoming aware of the same and again when they are entered into, at which time Developer shall also provide full details of the same.

29.6. Delivery of Changed Financing Documents

At any time an amendment is made to any Financing Document or Developer enters into a new Financing Document (or any agreement which affects the interpretation or application of any Financing Document), Developer shall deliver to the Enterprises a conformed copy of each such amendment or agreement within 10 Working Days of the date of its execution or creation (as applicable) certified as a true copy by an officer of Developer.

30. TAXES

[*To be provided in a subsequent Addendum.*]

31. RESTRICTIONS ON REVENUE GENERATING ACTIVITIES

31.1. Restrictions on Tolling

31.1.1. The Enterprises (and CDOT) have exclusive rights to impose tolls or any other user fees (in any form) in relation to the Project, including the right to deposit and allocate any resulting revenues as they determine in their discretion.

31.1.2. Developer hereby acknowledges and agrees that:

a. it has no right to:

i. impose tolls or any other user fees (in any form) in relation to the Project; or

ii. directly or indirectly engage in any revenue generating business on any part of the Site in connection with the Project, other than the conduct of its business pursuant to Section 8.1.2.a and the revenues it receives from the Enterprises pursuant to this Agreement;

b. it will not have any lien over or security interest in any toll revenues, user fees or other revenues generated by the Enterprises, CDOT or other Persons on any part of the Site or in connection with the Project.

31.2. Restrictions on Advertising

31.2.1. The Enterprises retain all rights relating to approving, planning and/or selling advertising on the Right-of-Way, any Additional Right-of-Way and any other Assets, and otherwise in connection with the Project.

31.2.2. Developer shall cooperate and grant all necessary access to the Enterprises and any Person authorized by the Enterprises in connection with the exercise of such rights.

PART K: DEFAULTS, REMEDIES AND TERMINATION

32. DEFAULTS AND REMEDIES

32.1. Developer Defaults and Cure Periods

32.1.1. The occurrence of any one of the events set out in the column titled “Developer Default” in the table below shall constitute a “Developer Default”. For purposes of this Agreement, "Developer Default Cure Period" means, in respect of a Developer Default, the cure period (if any) specified in the column titled "Cure Period" in the table below in the same row as such Developer Default, subject to extension in accordance with Section 32.1.2.

Developer Defaults

Developer Default	Cure Period
(1) An Insolvency Event occurs in respect of Developer. (2) An Insolvency Event occurs in respect of any Controlling Equity Member. (3) There is no: (a) replacement of an Insolvent Guarantor by a guarantor that is Approved by the Enterprises; or (b) provision of security for such Insolvent Guarantor’s guaranty in the form of a cash deposit, other payment or letter of credit in each case in an amount equal to the specified sum or specified maximum liability (or, absent such specified sum or maximum liability, the reasonably estimated maximum liability) under its guaranty, in either case within 30 Calendar Days of such Insolvency Event. (4) Developer fails to replace any Insolvent Principal Subcontractor with a counterparty Approved by the Enterprises within 60 Calendar Days of such Insolvency. (5) Developer fails to enter into: (a) a replacement Principal Subcontract and related guaranty (if any) with a counterparty Approved by the Enterprises within 60 Calendar Days of termination of such Principal Subcontract; or (b) a replacement guaranty within 30 Calendar Days of termination of a guaranty related to a Principal Subcontract that has not also been terminated. (6) The Substantial Completion Date does not occur on or prior to the Longstop Date. (7) A Noncompliance Default Event occurs. (8) A Closure Default Event occurs. (9) A Persistent Breach occurs. (10) Developer, or any Developer-Related Entity not acting independently of Developer, commits a Prohibited Act. (11) After exhaustion of all rights of appeal, there occurs any	None.

Developer Default	**Cure Period**
involuntary disqualification, suspension or debarment from bidding, proposing or contracting with any Governmental Authority (distinguished from ineligibility due to lack of financial qualifications) (any such event, an "Exclusion") of: (a) Developer; (b) any Equity Member with a financial obligation owing (at such date or a later date) to Developer for equity or loan contributions; (c) any affiliate of Developer (as "affiliate" is defined in 29 CFR § 16.105 or successor regulation of similar import) that is a Controlling Equity Member; (d) any Principal Subcontractor whose work is not completed at the date of the Exclusion, or any Guarantor of such Principal Subcontractor. (12) Developer fails to comply with any Safety Compliance Order pursuant to Section 23.1.3. (13) A Developer Default occurs pursuant to Section 26.2.1. (14) Developer makes or permits a transfer or assignment in breach of Section 39.1.	
(15) Developer fails to make any payment to the Enterprises pursuant or in relation to this Agreement when due (unless such payment is the subject of a good faith Dispute under the Dispute Resolution Procedures). (16) Unless Developer has delivered a Handback Letter of Credit that complies with the requirements of Section 4.5 of Schedule 12 (*Handback Requirements*), the amount standing to the credit of the Handback Reserve Account at any time after the commencement of the Handback Period is less than the Handback Reserve Amount. (17) Developer fails to procure and maintain: (a) any Contractor Bond required to be procured and maintained pursuant to Section 9.3.1 as required pursuant to Section 9.3.2; or (b) if Developer has elected pursuant to Section 4.5 of Schedule 12 (*Handback Requirements*) to provide a Handback Letter of Credit, such Handback Letter of Credit in accordance with the requirements of that Section 4.5. (18) Developer fails: (a) to obtain, provide, maintain and/or deliver originals, certificates or required evidence of any Insurance Policy as and when required under this Agreement for the benefit of relevant parties; or (b) to comply with any requirement of this Agreement pertaining to the amount, terms or coverage of the same,	15 Calendar Days after the date on which Enterprises deliver notice to Developer of the occurrence of the relevant Developer Default.

Developer Default		Cure Period
	in each case including pursuant to Section 25 and/or Schedule 13 (*Required Insurances*).	
(19)	An Abandonment occurs.	30 Calendar Days after the date on which Enterprises deliver notice to Developer of the occurrence of the relevant Developer Default.
(20)	Developer fails to comply with any Governmental Approval, Permit or Law in any material respect.	
(21)	Any Developer-Related Entity, acting independently of Developer, commits a Prohibited Act.	
(22)	An Insolvency Event occurs in respect of any Equity Member that is not a Controlling Equity Member.	30 Calendar Days (subject to extension in accordance with Section 32.1.2.a) after the date on which Enterprises deliver notice to Developer of the occurrence of the relevant Developer Default.
(23)	Subject to Section 5.4, any representation or warranty in this Agreement made by Developer pursuant to this Agreement, or in any certificate, schedule, report, instrument, agreement or other document delivered by or on behalf of Developer to the Enterprises pursuant to this Agreement, is false, misleading or inaccurate in any material respect when made or omits material information when made.	
(24)	An agreement comes into effect for voluntary Exclusion of: (a) Developer; (b) any Equity Member with a financial obligation owing (at such date or a later date) to Developer for equity or loan contributions; (c) any affiliate of Developer (as "affiliate" is defined in 29 CFR § 16.105 or successor regulation of similar import) that is not a Controlling Equity Member; or (d) any Principal Subcontractor whose work is not completed at the date of the Exclusion, or any Guarantor of such Principal Subcontractor.	
(25)	A violation by Developer of Section 53.5.	
(26)	A breach by Developer of any of its other material obligations under this Agreement, including any written repudiation of this Agreement, other than any breach that constitutes a Noncompliance Event or results in the accrual of a Construction Closure Deduction or an Operating Period Closure Deduction.	

32.1.2. For purposes of determining any Developer Default Cure Period in connection with a Developer Default pursuant to Section 32.2:

a. with respect to any Developer Default numbered (22), (24), (25) or (26) in Section 32.1.1 that requires a longer period to cure than the applicable Developer Default Cure Period, if Developer has within 15 Calendar Days of the start of the relevant Developer Default Cure Period proposed a rectification plan to be Approved by the Enterprises, then such Developer Default Cure Period shall be extended to the earliest of:

i. the latest date reasonably necessary to effect the cure thereof as set out in such plan;

ii. 120 Calendar Days from the start of Developer Default Cure Period; or

iii. the date on which Developer ceases its good faith efforts to cure such Developer Default in accordance with such plan;

b. with respect to Developer Default number (23) in Section 32.1.1, the cure will be complete when the adverse effects are cured;

c. with respect to Developer Defaults numbered (10) and (21) in Section 32.1.1, the cure must be Approved by the Enterprises;

d. with respect to Developer Default number (17), the Enterprises shall have the right, but not the obligation, to effect a cure, at Developer's expense, if such a Developer Default continues for more than five Calendar Days after the start of Developer Default Cure Period; and

e. any requirement of prior notice of Developer Default from the Enterprises to Developer to initiate the Cure Period shall be automatically waived if Developer knew of such default and failed to notify the Enterprises of such default, in which case Developer Default Cure Period shall start on the date that Developer first becomes (or should have become) aware of such Developer Default.

32.2. Enterprises Remedies for Developer Default

32.2.1. If any Developer Default occurs and has not been cured by the expiry of the applicable Developer Default Cure Period, the Enterprises may in their discretion:

a. subject to Lenders' rights pursuant to the Lenders Direct Agreement, terminate this Agreement pursuant to Section 33.1.3;

b. exercise their rights of self-help pursuant to Sections 23.4.2 to 23.4.4 as provided in Section 23.4.1.b;

c. by notice to Developer, grant Developer an extended Developer Default Cure Period (in addition to any other extension pursuant to Section 32.1.2.a) subject to such conditions as the Enterprises may require in their discretion;

d. exercise their rights under Section 9.3.3 with respect to any payment and performance security; and/or

e. waive such default in accordance with Section 43.3.

32.2.2. The Enterprises' rights and remedies with respect to the occurrence of any Developer Default are without limitation to its rights and remedies with respect to the occurrence of any other Developer Default.

32.3. Enterprise Defaults and Cure Periods

32.3.1. The occurrence of any one of the events set out in the column titled "Enterprise Default" in the table below shall constitute an "Enterprise Default". For purposes of this Agreement, "Enterprise Default Cure Period" means, in respect of an Enterprise Default, the cure period specified in the

column titled "Cure Period" in the table below in the same row as such Enterprise Default, subject to extension in accordance with Section 32.3.2.

Enterprise Defaults

Enterprise Default	**Cure Period**
(1) The Enterprises fail to make any payment to Developer under this Agreement when due (unless such payment is the subject of a good faith Dispute under the Dispute Resolution Procedures). (2) The Enterprises make an assignment or transfer in breach of Section 39.2. (3) A breach or breaches by the Enterprises of any of their obligations under this Agreement that (in the case of more than one breach, when taken together) substantially frustrates or renders it impossible for Developer to perform all or a substantial part of its obligations or to exercise all or a substantial part of its rights under this Agreement in each case for a continuous period of 60 Calendar Days.	45 Calendar Days after the date on which Developer delivers notice to Enterprises of the occurrence of the relevant Enterprise Default.
(4) Subject to Section 5.4, any representation or warranty made by either Enterprise pursuant to Section 5.1.2 is false, misleading or inaccurate in any material respect when made or omits material information when made. (5) Either of the Enterprises, CDOT, the State or any other State Governmental Authority confiscates, sequesters, condemns or appropriates all or a material part of: (a) the Project; (b) the Assets; (c) ownership interests in Developer; (d) Developer's interests in this Agreement, excluding the exercise of any right of termination pursuant to this Agreement and any Change, Relief Event or Compensation Event.	90 Calendar Days (subject to extension in accordance with Section 32.3.2.a) after the date on which Developer delivers notice to Enterprises of the occurrence of the relevant Enterprise Default.

32.3.2. For purposes of applying any Enterprise Default Cure Period in connection with an Enterprise Default pursuant to Section 32.4:

a. with respect to any Enterprise Default numbered (4) and (5) in Section 32.3.1 that requires a longer period to cure than the applicable Enterprise Default Cure Period, if the Enterprises have within the relevant Enterprise Default Cure Period notified Developer of such conclusion, then such Enterprise Default Cure Period shall be extended to the earlier of:

i. the latest date reasonably necessary to effect the cure thereof as set out in such plan; or

ii. 180 Calendar Days from start of the Enterprise Cure Period; and

b. with respect to Enterprise Default number (4) in Section 32.3.1, the cure will be complete when the adverse effects are cured.

32.4. Developer Remedies for Enterprise Default

32.4.1. If any Enterprise Default occurs and has not been cured within the applicable Enterprise Default Cure Period, Developer may in its discretion:

a. terminate this Agreement pursuant to Section 33.1.4;

b. by notice to the Enterprises, grant the Enterprises an extended Enterprise Default Cure Period (in addition to any other extension pursuant to Section 32.3.2); and/or

c. waive such default in accordance with Section 43.3.

32.4.2. Developer's rights and remedies with respect to the occurrence of any Enterprise Default are without limitation to its rights and remedies with respect to the occurrence of any other Enterprise Default.

33. TERMINATION

33.1. Termination Events

33.1.1. Exclusive Rights to Terminate

a. Prior to Financial Close, the Parties' sole right to terminate this Agreement shall be pursuant to Schedule 1 (*Financial Close*). On and from the Financial Close, this Agreement is subject to termination pursuant to Sections 33.1.2 through 33.1.7.

b. This Section 33, together with the other provisions of this Agreement expressly referred to in this Section 33 and the provisions of the Lenders Direct Agreement, contain the entire and exclusive provisions and rights of the Enterprises and Developer regarding termination of this Agreement, and any and all other rights to terminate at Law or in equity are hereby waived to the maximum extent permitted by Law, provided that termination of this Agreement shall not relieve Developer, or any Guarantor, insurer or any surety or other financial institution that provides a Contractor Bond, of its obligation for any Claims arising prior to termination.

33.1.2. Termination for Convenience

a. The Enterprises may, in their discretion and subject to prior notice in accordance with Section 33.1.2.b, terminate this Agreement at any time on or before the Expiry Date by delivering to Developer a Termination Notice to such effect (a "Termination for Convenience").

b. Any such Termination for Convenience shall be effective 30 Calendar Days from the date of the Termination Notice, or on such later date as the Enterprises may specify in such notice.

c. As a consequence of a Termination for Convenience, the Enterprises shall pay the Termination Amount to Developer as determined pursuant to Schedule 7 (*Compensation on Termination*).

33.1.3. Termination for Developer Default

a. If a Developer Default occurs and has not been cured within the applicable Developer Default Cure Period, the Enterprises may, in their discretion and subject to prior notice in accordance with Section 33.1.3.b and the Lenders' rights pursuant to the Lenders Direct

Agreement, terminate this Agreement at any time that such default is continuing by delivering to Developer a Termination Notice to such effect.

b. Subject to the terms of the Lenders Direct Agreement, any such termination for Developer Default shall be effective 30 Calendar Days from the date of the Termination Notice, or on such later date as the Enterprises may specify in such notice.

c. As a consequence of any termination for Developer Default, the Enterprises shall pay the Termination Amount to Developer as determined pursuant to Schedule 7 (*Compensation on Termination*).

33.1.4. Termination for Enterprise Default

a. If an Enterprise Default occurs and has not been cured within the applicable Enterprise Default Cure Period, Developer may, in its discretion and subject to prior notice in accordance with Section 33.1.4.b, terminate this Agreement at any time that such default is continuing by delivering to the Enterprises a Termination Notice to such effect.

b. Any such termination for Enterprise Default shall be effective 30 Calendar Days from the date of the Termination Notice.

c. As a consequence of any termination for Enterprise Default, the Enterprises shall be obligated to pay the Termination Amount to Developer as determined pursuant to Schedule 7 (*Compensation on Termination*).

33.1.5. Termination for Court Ruling

a. Any Termination by Court Ruling shall become effective and automatically terminate Agreement upon issuance of the final, non-appealable court order by a court of competent jurisdiction.

b. As a consequence of any Termination by Court Ruling, the Enterprises shall pay the Termination Amount to Developer as determined pursuant to Schedule 7 (*Compensation on Termination*).

33.1.6. Termination for Extended Force Majeure

a. If any Force Majeure Event that causes one or both Parties to be unable to comply with any material obligation under this Agreement occurs and is continuing for a continuous period of at least 180 Calendar Days so as to frustrate the overall purpose and intent of this Agreement, then either Party may in its discretion, subject to Section 33.1.6.b, terminate this Agreement at any time that such Force Majeure Event is continuing by delivering to the other Party a Termination Notice to such effect a ("Termination for Extended Force Majeure").

b. Any such termination shall be effective 30 Calendar Days from the date of the Termination Notice, provided that in response to a Termination Notice delivered by Developer during the Operating Period the Enterprises may, in their discretion, reject such Termination Notice (without limiting the Enterprises' own right to subsequently deliver such a Termination Notice) within 10 Working Days of receipt, in which case:

i. the Enterprises shall pay to Developer:

A. Performance Payments in respect of the period from the Calendar Day after the date on which this Agreement would have otherwise terminated

as if the Work was being fully performed pursuant to the requirements of this Agreement (net of (I) the avoidable costs of Work not being performed as a result of the occurrence of such Force Majeure Event, (II) the amount that Developer is or should be entitled to recover under any "business interruption" coverage under the Available Insurance and (III) deductions equal to the average Monthly Performance Deductions for the 12 Payment Months (or, if the Termination Notice was delivered less than 12 Payment Months after the Substantial Completion Date, such lesser number of Payment Months) prior to the month in which the Termination Notice was delivered; and

B. all other Losses, fees and expenses caused by any damage or delay (to the extent not covered by insurance proceeds) resulting from such Force Majeure Event following the date of Developer's Termination Notice; and

ii. Developer shall remain responsible for the continuation of the Work to the extent not relieved of its obligations pursuant to Section 15.3.1.c as a result of the occurrence of such Force Majeure Event.

c. As a consequence of any Termination for Extended Force Majeure, the Enterprises shall pay the Termination Amount to Developer as determined pursuant to Schedule 7 (*Compensation on Termination*).

33.1.7. Termination for Uninsurable Risk

[*To be added in a subsequent Addendum.*]

33.2. Consequences of Termination

On the Termination Date as determined pursuant to Sections 33.1.2 through 33.1.7, this Agreement shall automatically terminate.

33.3. No Increased Termination Liabilities

Notwithstanding any other provision of this Agreement, no amendment or waiver of any provision of, or exercise of any right under, this Agreement or any Principal Subcontract or Financing Agreement, including any Refinancing, shall have the effect of increasing the amount of the Enterprises' liabilities as of the Termination Date (including the amount of any Termination Amount), unless Developer has obtained the prior written consent of the Enterprises to such amendment, waiver or exercise (which consent shall be given as expressly provided for in this Agreement, and otherwise in the Enterprises' discretion).

33.4. Exclusivity of Remedy

Any Termination Amount irrevocably paid by the Enterprises to Developer shall be in full and final settlement of Developer's or any Developer-Related Entity's rights and claims against the Enterprises, CDOT and the State for, or in connection with, breaches and/or termination of this Agreement whether under contract, tort, restitution or otherwise, but without prejudice to:

a. any antecedent liability of the Enterprises to Developer that arose prior to the Termination Date (but not from the termination itself) to the extent such liability has not already been taken into account in the determination of the Termination Amount; and

b. any liabilities arising in respect of any breach by the Enterprises after the Termination Date of any obligation under this Agreement that survives the Termination Date, to the

extent such liability has not already been taken into account in the determination of any Termination Amount.

34. HANDOVER PREPARATIONS AND ACTIVITIES

34.1. Preparations for Handover

34.1.1. During:

a. the final 24 months prior to the Expiry Date; or

b. from service of any Termination Notice until the Termination Date,

as applicable, and in either case for a period of time thereafter as reasonably required by the Enterprises, Developer shall, without limiting its other obligations under this Agreement, use Reasonable Efforts to cooperate and coordinate with the transfer with effect from the Expiry Date or Termination Date, as applicable, of responsibility for the Work to the Enterprises and/or any Person designated by the Enterprises.

34.1.2. For purposes of Section 34.1.1, Developer's obligations to cooperate and coordinate shall include:

a. cooperating with the Enterprises and/or any Person designated by them, and providing reasonable assistance and advice concerning the Work and its transfer to the Enterprises and/or to such Person;

b. providing to the Enterprises and/or their designee with:

i. Site access pursuant to Section 21.1.1; and

ii. pursuant to Section 19.1, access to and, on request pursuant to Section 19.1.3.c, copies of, all Project Records including all:

A. information on the identity, terms and conditions of employment of all employees of Developer or any Principal Subcontractor employed in the provision of the Work;

B. manuals;

C. equipment logs;

D. drawings;

E. files; and

F. specifications,

as reasonably required for the efficient transfer of responsibility of performance of the Project, and Developer shall warrant that, to the best of its knowledge and belief, the information contained in such Project Records is accurate in all material respects;

c. using Reasonable Efforts to complete all reasonably necessary preliminary acts (including entering into any contracts) to ensure its ability to comply with its obligations under Section 34.2.1 on and from the Expiry Date or the Termination Date, as applicable; and

d. complying with Section 12.1 where, for such purposes, an "Other Department Project" shall be deemed to prospectively include the Project following the future occurrence of the Expiry Date or Termination Date, as applicable.

34.1.3. In addition to Developer's obligations under Sections 34.1.1 and 34.1.2, on or before a date falling no earlier than 30 months prior to the Expiry Date, and otherwise in connection with a Termination for Convenience, the Enterprises may, in their discretion, notify Developer whether they wish to retender the provision of the Work (in whole or in part), in which case from the date of such notice, Developer shall comply with Section 12.2 shall apply where, for such purposes, an "Other Department Project" shall be deemed to prospectively include the Project following the future occurrence of the Expiry Date or Termination Date, as applicable.

34.2. Assignments and Transfers

34.2.1. On the Expiry Date (or, if earlier, on the Termination Date), and subject to the Lenders Direct Agreement and the Principal Subcontractor Direct Agreements, Developer shall, without limiting its other obligations under this Agreement:

a. unless the Enterprises elect in writing to the contrary, assign and transfer to the Enterprises, and/or any Person designated by the Enterprises, for no additional payment:

i. the benefit of any and all Principal Subcontracts and/or other direct contractual arrangements (as may be reasonably required by the Enterprises) that Developer may have with any third parties in relation to the Project;

ii. all Governmental Approvals and Permits; and

iii. its rights, title and interest in and to:

A. the Transferrable Assets;

B. warranties associated with the Transferrable Assets (including those referenced in Section 9.4.6); and

C. all intellectual property (including software licenses);

in the case of software together with:

D. administrator access to each proprietary system software package and workstation, so that the Enterprises can maintain the software system and create users as required for the use of each software package; and

E. source code, and an agreement for the use and maintenance of any product for a period of five years from the Expiry Date (or, if earlier, the Termination Date) for any proprietary software that is not commercial off-the-shelf software,

provided that if, for any reason, Developer cannot assign and transfer its interest in any of the foregoing, it shall declare a trust of all its beneficial interest in the same for the benefit of the Enterprises and/or their designee, or make such other arrangements as the Enterprises may reasonably require; and

b. take any such other actions in relation to Intellectual Property rights as is required pursuant to Section 52,

and Developer hereby irrevocably and unconditionally appoints the Enterprises as Developer's lawful attorney (and to the complete exclusion of any rights that Developer may have in such regard) for the purpose of generally executing or approving such deeds or documents and doing any such acts or things necessary to give effect to the provisions of this Section 34.2.1 as the Enterprises may in their discretion think fit.

34.2.2. Developer shall no later than 20 Working Days after the Expiry Date (or, if earlier, the Termination Date) hand over to the Enterprises all Project Records (or complete and accurate copies to the extent originals are not required by the Enterprises) by whatever means and in whatever format the Enterprises require that are in the possession, custody or power of Developer or Principal/all Subcontractors and other Developer-Related Entities.

34.3. No Contrary Activities

Developer shall not take any action (or refrain from taking any action) in a manner that is calculated or intended to directly or indirectly prejudice or frustrate or make more difficult any of the activities contemplated under Section 34.1 or any transfer or assignment contemplated under Section 34.2.

PART L: LIMITATIONS ON LIABILITY

35. REMEDIES AND LIABILITY

35.1. Developer's Sole Remedies

Subject to Section 35.2, Developer's sole remedy in relation to matters for which an express right or remedy is stated in this Agreement, including for any Supervening Event, shall be that right or remedy and Developer shall have no additional right or remedy however arising.

35.2. No Double Recovery

Notwithstanding any other provision of this Agreement, no Party shall be entitled to recover compensation under this Agreement or any other agreement in relation to the Project in respect of any Loss that it has incurred to the extent that it has already been compensated in respect of that Loss pursuant to this Agreement or otherwise.

35.3. Enterprises' Sole Remedy for Developer's Failure to Perform Work

Without prejudice to:

a. any other express right of the Enterprises pursuant to this Agreement (other than the right of a Principal Indemnified Party to be indemnified pursuant to Section 24.2 from and against Claims asserted against it and/or Losses suffered by it, except for its right to be indemnified in respect of Claims and/or Losses referred to in Sections 35.3.c and 35.3.d); and

b. the Enterprises' right to claim, on or after termination of this Agreement, the amount of its reasonable Losses suffered as a result of, or incurred by it as a result of rectifying or mitigating the effects of, any breach of this Agreement by Developer or the occurrence of any Developer Default, save to the extent that the same has already been recovered by the Enterprises pursuant to this Agreement or has been taken into account in the calculation of any Termination Amount,

the sole remedy of the Enterprises in respect of any Noncompliance Event or Non-Permitted Closure shall be the operation of Schedule 6 (*Performance Mechanism*), provided that such limitation shall not apply in respect of:

c. Claims asserted against a Principal Indemnified Party by any other Person (including, for certainty, an Indemnified Party who is not a Principal Indemnified Party) and/or Losses suffered by a Principal Indemnified Party as a result of any such Claim; or

d. Losses suffered by a Principal Indemnified Party as a result of any of the events or circumstances referred to in Sections 24.2.b, 24.2.d, 24.2.e or 24.2.f (other than, in the case of any Non-Permitted Closure, loss of use of any travel lane, ramp, cross street, shoulder, sidewalk or driveway).

35.4. Non-financial Remedies

Without prejudice to the other rights and remedies under the express terms of this Agreement, nothing in Sections 35.2 and 35.3 shall prevent or restrict the right of the Enterprises or Developer to seek any non-financial remedies from the court pursuant to the Dispute Resolution Procedures.

35.5. Available Insurance

Developer shall not be entitled to any payment or credit (or any portion of either thereof) which would have been due, or from which it would have otherwise received a benefit, under this Agreement to the extent that it is or should be able to recover the amount or receive the benefit of such payment or credit (or such portion) under:

a. any Insurance Policy (whether or not such insurance has in fact been effected or, if effected, has been vitiated, cancelled or declared void as a result of any act or omission of Developer (or any other Developer-Related Party), including due to non-disclosure or under-insurance);

b. any other policy of insurance that Developer has taken out and maintained (excluding, for certainty, any credit enhancement policy related to the Project Debt); or

c. any other policy of insurance that Developer is entitled to claim under as an additional insured,

a., b. and c. together, the "Available Insurance".

35.6. Waiver of Consequential Damages

a. Subject to Section 35.6.b, neither Party shall be liable to the other for any punitive, indirect, incidental or consequential damages of any nature, whether arising out of a breach of this Agreement, tort (including negligence) or other legal theory of liability.

b. The limitation set out in Section 35.6.a shall not apply to:

i. any amounts expressly payable pursuant to the terms of this Agreement or any amounts entitled to be offset pursuant to Section 53.7;

ii. any Monthly Performance Deduction and/or Monthly Construction Closure Deduction the Enterprises are entitled to make pursuant to Schedule 6 (*Performance Mechanism*);

iii. Developer's liability for:

A. Claims and/or Losses (including defense costs) to the extent that they are either covered by or should be covered by Available Insurance;

B. Claims and/or Losses arising out of or relating to any Developer Release of Hazardous Substances;

C. amounts payable by Developer under an indemnity pursuant to this Agreement (but only to the extent such indemnity relates to a Claim asserted and/or Losses suffered by any Person other than a Principal Indemnified Party); and

D. Claims and/or Losses by a Principal Indemnified Party of grants, fees, funds or revenues (including toll revenues); and

iv. any Party's liability for Losses arising out of fraud, willful misconduct, criminal conduct, recklessness, bad faith or gross negligence on the part of the relevant Party (including, with respect to Developer, that of any other Developer-Related Party).

PART M: CHOICE OF LAW, JURISDICTION AND DISPUTE RESOLUTION

36. CHOICE OF LAW

Colorado law, and rules and regulations issued pursuant thereto, shall be applied in the interpretation, execution, and enforcement of this Agreement. Any provision included or incorporated herein by reference which conflicts with said laws, rules, and regulations shall be null and void. Any provision incorporated herein by reference which purports to negate this or any other Special Provision in whole or in part shall not be valid or enforceable or available in any action at law, whether by way of complaint, defense, or otherwise. Any provision rendered null and void by the operation of this provision shall not invalidate the remainder of this Agreement, to the extent capable of execution.

37. JURISDICTION

[*To be provided in a subsequent Addendum.*]

38. DISPUTE RESOLUTION

[*To be provided in a subsequent Addendum.*]

PART N: MISCELLANEOUS

39. ASSIGNMENTS AND TRANSFERS

39.1. Assignments and Transfers by Developer

Except to the extent permitted by Section 27.3, Developer shall not, and shall not permit, any assignment, transfer, mortgage, pledge or encumbrance of any of its interests in the Project, the Site or the Work, or its interests in, or rights or obligations under this Agreement, the Subcontracts, any Contractor Bond and the Insurance Policies, without the Enterprises' Approval.

39.2. Assignments and Transfers by the Enterprises

Each Enterprise may assign, transfer, mortgage, pledge and/or encumber its interests in the Project, the Right-of-Way, any Additional Right-of-Way, the Work or, its interests in, or rights or obligations under, this Agreement, any Contractor Bond, the Lenders Direct Agreement, any Principal Subcontractor Direct Agreement and/or the Insurance Policies to:

a. the other Enterprise and/or CDOT:

   i. pursuant to Section 18.1; and

   ii. otherwise to the extent not prohibited by Law;

b. any Governmental Authority of the State that either individually or collectively with one or more other Governmental Authorities of the State, succeeds to or assumes all of such Enterprise's rights and obligations in and under this Project and this Agreement; or

c. any other Person:

   i. with the prior written consent of Developer, which consent shall not be unreasonably withheld; or

   ii. otherwise following a Change of this Agreement, but only with respect to such portion of its interest in the Project that is no longer part of the Project as a result of such Change.

40. BINDING EFFECT; SUCCESSORS AND ASSIGNS

This Agreement shall be binding upon and inure to the benefit of each Enterprise and Developer and each of their respective permitted successors and assigns.

41. SURVIVAL

The following provisions shall survive expiration or earlier termination of this Agreement and/or completion of the Work:[3]

a. each Party's representations and warranties made pursuant to Section 5.1 and, pursuant to Schedule 1 (*Financial Close*), subsequently repeated;

b. all rights with respect to Contractor Bonds under Section 9.3.3;

c. all Warranties and liability for Defects and breaches pursuant to Section 9.4;

[3] List of surviving provisions to be definitively confirmed in a subsequent Addendum.

d. the indemnifications, limitations and releases set out in Sections 24 and 35;

e. the Dispute Resolution Procedures;

f. the handover and handback provisions set out in Sections 13 and 34 and Schedule 12 (*Handback*);

g. all provisions related to the consequences of termination of this Agreement, including Sections 33.2, 33.3 and 33.4;

h. any other provisions which, either expressly or by their context, are intended to operate after termination or expiration of this Agreement and/or completion of the Work; and

i. any other provisions if and to the extent necessary for the interpretation of the foregoing.

42. CONSTRUING THIS AGREEMENT

42.1. Entire Agreement

42.1.1. This Agreement constitutes the entire agreement among the Enterprises and Developer concerning the subject matter hereof and supersedes all prior negotiations, representations, and agreements, either oral or written, among the Parties with respect to their subject matter.

42.1.2. Each of the Parties acknowledges that, except as expressly provided in this Agreement, no Party enters into this Agreement on the basis of, and no Party relies, or has relied, upon, any statement, representation, warranty or other provision (in any case whether oral, written, express or implied) made or agreed to by any Person (whether a Party to this Agreement or not) except those made pursuant to Section 5.1 and, pursuant to Schedule 1 (*Financial Close*), subsequently repeated, where the only remedy or remedies available in respect of any misrepresentation or untrue statement made to it shall be any remedy available under this Agreement), provided that this Section 42.1.2 shall not apply to any statement, representation or warranty made fraudulently, recklessly, in bad faith, as a result of gross negligence, willfully or criminally, or to any provisions of this Agreement which were induced by the same, for which the remedies available shall be all those available under the law governing this Agreement.

42.2. Interpretation

42.2.1. The language in all parts of this Agreement shall in all cases be construed simply, as a whole and pursuant to its fair meaning and not strictly for or against any Party.

42.2.2. The Parties hereto acknowledge and agree that this Agreement is the product of an extensive and thorough arm's length exchange of ideas, questions, answers information and drafts during the Proposal preparation process pursuant to the ITP.

42.2.3. Developer further acknowledges and agrees that it has independently reviewed this Agreement with legal counsel and other advisors and that Developer has, itself or through other arrangements, the requisite experience and sophistication to understand, interpret and agree to this Agreement. Accordingly, in the event of any ambiguity in, or dispute regarding the interpretation of, the provisions of this Agreement, the terms of this Agreement shall not be construed against the Persons that prepared them.

42.3. Severability

42.3.1. If any provision (or part of any provision) of this Agreement is ruled invalid (including due to Change in Law) by a court having proper jurisdiction, then the Parties shall:

a. promptly meet and negotiate a substitute for such provision or part thereof which shall, to the greatest extent legally permissible, effect the original intent of the Parties; and

b. if necessary or desirable, apply to the court which declared such invalidity for an interpretation of the invalidated provision (or part thereof) to guide the negotiations.

42.3.2. If any provision (or part of any provision) of this Agreement shall, for any reason, be held to be invalid, illegal, or unenforceable in any respect, such provision (or part thereof) shall not affect the validity, legality and enforceability of any other provision of (or the other part of such provision) or any other documents referred to in this Agreement, and this Agreement shall be construed as if such invalid, illegal, or unenforceable provision (or part thereof) had never been contained herein.

43. AMENDMENTS AND WAIVERS

43.1. Amendments

This Agreement may only be amended by a written amendment duly executed by both Parties together with, to the extent required by Law, the Colorado State Controller or their designee, unless the amendment to this Agreement is expressly allowed or required to be made in any other manner pursuant to this Agreement and Law.

43.2. Rights and Remedies Cumulative

Except to the extent otherwise expressly provided in this Agreement, including in Sections 33.4 and 35, the rights and remedies of the Enterprises hereunder are cumulative and are not exclusive of any rights or remedies that the Enterprises would otherwise have.

43.3. Waivers

Except to the extent otherwise expressly provided in this Agreement:

a. any waiver of, or consent to depart from, the requirements of any provision of this Agreement shall be approved in the discretion of the Party giving it and shall be effective only if it is in writing by such Party, and only in the specific instance, for the specific time, subject to the specific conditions and for the specific purpose for which it has been given;

b. no failure on the part of any Party to exercise, and no delay in exercising, any right or power under this Agreement shall operate as a waiver of such right or power; and

c. no single or partial exercise of any right or power under this Agreement, including any right to give or withhold any consent, approval or Acceptance, nor any abandonment or discontinuance of steps to enforce such a right or power, shall preclude or render unnecessary any other or further exercise of such right or the exercise of any other right.

44. SET-OFF AND DEFAULT INTEREST

44.1.1. The Parties shall each have their respective set-off rights pursuant to Section 5 of Part 3 of Schedule 4 (*Payment*) with respect to their respective payment obligations under this Agreement.

44.1.2. In the event that any of the Parties fails to pay any amount under this Agreement on the due date therefor, interest shall apply and be calculated pursuant to Section 3 of Part 3 of Schedule 4 (*Payment*).

45. LIMITATION ON THIRD-PARTY BENEFICIARIES

It is not intended by any of the provisions of this Agreement to create any third-party beneficiary rights hereunder, or to authorize anyone not a Party hereto to maintain a suit for personal injury or property damage pursuant to the terms or provisions hereof, except to the extent that Section 9.4 identifies the Warranty Beneficiaries and states that they are entitled to certain benefits thereunder. Notwithstanding the foregoing, the duties, obligations and responsibilities of the Parties with respect to third parties shall remain as imposed by Law.

46. INDEPENDENT DEVELOPER

46.1. Developer as an Independent Project Contractor

Developer shall perform its duties hereunder as an independent Developer and not as an employee. Neither Developer nor any agent or employee of Developer shall be deemed to be an agent or employee of the State. Developer and its employees and agents are not entitled to unemployment insurance or workers compensation benefits through the State and the State shall not pay for or otherwise provide such coverage for Developer or any of its agents or employees. Unemployment insurance benefits will be available to Developer and its employees and agents only if such coverage is made available by Developer or a third party. Developer shall pay when due all applicable employment taxes and income taxes and local head taxes incurred pursuant to this Agreement. Developer shall not have authorization, express or implied, to bind the State to any agreement, liability or understanding, except as expressly set out herein.

46.2. No Partnership or Similar Relationship

46.2.1. Nothing in this Agreement is intended or shall be construed to create any partnership, joint venture or similar relationship between Developer and the Enterprises.

46.2.2. While the term “public-private partnership” may be used on occasion to refer to relationships of the type created pursuant to this Agreement, the Parties do not have or express any intention to form or hold themselves out as a de jure or de facto partnership, joint venture or similar relationship, to share net profits or net losses, or to give the Enterprises or Developer any rights to direct or control the activities of the other or their respective Affiliates, subcontractors or consultants, except as otherwise expressly provided in this Agreement.

46.3. No Relationship with Developer’s Employees and Subcontractors

46.3.1. Other than with respect to the Lenders Direct Agreement and the Principal Subcontractor Direct Agreements, in no event shall the relationship between the Enterprises and Developer be construed as creating any relationship whatsoever, including, for certainty, a contractual relationship, between the Enterprises and:

a. Developer’s employees;

b. any Subcontractor; or

c. any other Person.

46.3.2. Neither Developer nor any of its employees or Subcontractors is or shall be deemed to be an employee or Subcontractor of the Enterprises.

46.3.3. Except to the extent as otherwise expressly provided in this Agreement, Developer has sole authority and responsibility to employ, discharge and otherwise control its employees and Subcontractors and has complete and sole responsibility as a principal for its agents, for

employees and all Subcontractors and for all other Persons that Developer or any Subcontractor hires to perform or assist in performing the Work.

47. NO PERSONAL LIABILITY

Each Enterprise's authorized representatives, including the Enterprise Representative, are acting solely as agents and representatives of the Enterprises when carrying out the provisions of or exercising the power or authority granted to them under this Agreement, and, as such, none of them shall not be liable either personally or as employees of the Enterprises for actions in their ordinary course of employment.

48. NO FEDERAL GOVERNMENT OBLIGATIONS

Developer acknowledges and agrees that, notwithstanding any concurrence or approval by the United States Federal government in of the solicitation and award of this Agreement, the United States Federal government is not a party to this Agreement and shall not be subject to any obligations or liabilities to the Enterprises, Developer, or any other Person (whether or not a Party to this Agreement) pertaining to any matter resulting from this Agreement.

49. NOTICES

49.1. Methods of Notice Submission

49.1.1. Except with respect to any service of process, any notice, and any other Approval, Acceptance, consent, approval or like assent, comment, Deliverable, election, demand, direction, designation, request, agreement, instrument, certificate, report or other communication required or permitted to be given or made under this Agreement (each, a "notice" or, alternatively, a "Notice") to another Party must be given in writing through the then current Document Control System.

49.1.2. Any service of process, and any other notice (but if and only if such notice is delivered at a time when the Document Control System is unavailable), shall be given in writing by means of physical, digital or electronic communication, but, except to the extent the Enterprises otherwise Approve excluding the use of social media, messengering, broadcast and equivalent services, to the relevant Party at the following addresses, as applicable:

Developer		Enterprises	
Attention:	[ ]	Attention:	[ ]
[*Address*]		[*Address*]	
Phone:	[ ]	Phone:	[ ]
Mobile:	[ ]	Mobile:	[ ]
Fax (optional):	[ ]	Fax (optional):	[ ]
Email:	[ ]	Email:	[ ]

49.2. Time and Date of Notice Submission

49.2.1. A notice shall be deemed to have been submitted:

a. if submitted through the Document Control System, when recorded as submitted by such system; and

b. otherwise:

i. upon receipt (confirmed by automatic answer back, read receipt or equivalent evidence of receipt), if validly transmitted by digital or electronic distribution before 3:00 p.m. (local time at the place of receipt) on a Working Day;

ii. upon receipt, if physically delivered in person or by courier; or

iii. three Working Days after deposit with postage prepaid and properly addressed, if delivered by United States certified or registered mail.

49.3. Changes in Address

The Parties will notify each other in writing of any change of address and/or contract information, such notification to become effective five Working Days after notification.

50. FURTHER ASSURANCES

Developer shall promptly execute and deliver to the Enterprises all such instruments and other documents and assurances as are reasonably requested by the Enterprises to further evidence the obligations of Developer hereunder, including assurances regarding the obligations of Subcontractors referenced herein.

51. COSTS AND EXPENSES OF THE PARTIES

Except as otherwise expressly provided in this Agreement, each Party shall bear its own costs and expenses (including legal and other advisers' fees and expenses) in connection with the preparation, negotiation, execution and performance of this Agreement and all other related agreements.

52. INTELLECTUAL PROPERTY RIGHTS

[*To be provided in a subsequent Addendum.*]

53. SPECIAL PROVISIONS

53.1. Controller's Approval

This Agreement shall not be valid until it has been approved by the Colorado State Controller or designee.

53.2. Governmental Immunity

No term or condition of this Agreement shall be construed or interpreted as a waiver, express or implied, of any of the immunities, rights, benefits, protections, or other provisions, of the Colorado Governmental Immunity Act, C.R.S. §§24-10-101 et seq., or the Federal Tort Claims Act, 28 U.S.C. §§1346(b) and 2671 *et seq*., as applicable now or hereafter amended.

53.3. Compliance with Law

Developer shall strictly comply with all applicable Federal and State laws, rules, and regulations in effect or hereafter established, including, without limitation, laws applicable to discrimination and unfair employment practices.

53.4. Binding Arbitration Prohibited

The State does not agree to binding arbitration by any extra-judicial body or person. Any provision to the contrary in this Agreement or incorporated herein by reference shall be null and void.

53.5. Software Piracy Prohibition

State or other public funds payable under this Agreement shall not be used for the acquisition, operation, or maintenance of computer software in violation of federal copyright laws or applicable licensing restrictions. Developer hereby certifies and warrants that, during the term of this Agreement and any extensions, Developer has and shall maintain in place appropriate systems and controls to prevent such improper use of public funds. If the State determines that Developer is in violation of this provision, the State may exercise any remedy available at law or in equity or under this Agreement, including, without limitation, termination of this Agreement pursuant to Section 32.2.1.a for a Developer Default numbered (25) in Section 32.1.1, as well as any remedy consistent with Federal copyright laws or applicable licensing restrictions.

53.6. Employee Financial Interest / Conflict of Interest

The signatories aver that to their knowledge, no employee of the State has any personal or beneficial interest whatsoever in the service or property described in this Agreement. Developer has no interest and shall not acquire any interest, direct or indirect, that would conflict in any manner or degree with the performance of Developer's services and Developer shall not employ any person having such known interests.

53.7. Vendor Offset (C.R.S. §§24-30-202 (1) and 24-30-202.4)

Subject to C.R.S. §24-30-202.4 (3.5), the State Controller, or the Enterprises, may withhold payment under the State's vendor offset intercept system for debts owed to State agencies for:

a. unpaid child support debts or child support arrearages;

b. unpaid balances of tax, accrued interest, or other charges specified in C.R.S. §39-21-101, *et seq*.;

c. unpaid loans due to the Student Loan Division of the Department of Higher Education;

d. amounts required to be paid to the Unemployment Compensation Fund; and

e. other unpaid debts owing to the State as a result of final agency determination or judicial action.

53.8. Public Contracts for Services

Developer certifies, warrants, and agrees that it does not knowingly employ or contract with an illegal alien who will perform work under this Agreement and will confirm the employment eligibility of all employees who are newly hired for employment in the United States to perform work under this Agreement, through participation in the E-Verify Program or the CDOT program established pursuant to C.R.S. §8-17.5-102(5)(c), Developer shall not knowingly employ or contract with an illegal alien to perform work under this Agreement or enter into a contract with a Subcontractor that fails to certify to Developer that the Subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this Agreement. Developer:

a. shall not use E-Verify Program or CDOT program procedures to undertake pre-employment screening of job applicants while this Agreement is being performed;

b. shall notify the Subcontractor and the contracting State agency within three Calendar Days if Developer has actual knowledge that a Subcontractor is employing or contracting with an illegal alien for work under this Agreement;

c. shall terminate the subcontract if a Subcontractor does not stop employing or contracting with the illegal alien within three Calendar Days of receiving the notice; and

d. shall comply with reasonable requests made in the course of an investigation, undertaken pursuant to C.R.S. § 8-17.5-102(5), by the Colorado Department of Labor and Employment.

If Developer participates in the CDOT program, Developer shall deliver to the contracting State agency, institution of higher education or political subdivision a written, notarized affirmation, affirming that Developer has examined the legal work status of such employee, and shall comply with all of the other requirements of the CDOT program. If Developer fails to comply with any requirement of this provision or C.R.S. § 8-17.5-101, *et seq.*, the contracting State agency may terminate this Agreement for breach and, if so terminated, Developer shall be liable for damages.

54. COUNTERPARTS

This Agreement (and an amendment or waiver in respect to this Agreement) may be executed in one or more counterparts (including by electronic signature and/or scanned or digital transmission). Any single counterpart or a set of counterparts executed, in either case, by each of the Parties and, to the extent required by Law, the State Controller or their designee, shall constitute a full and original instrument for all purposes.

[*remainder of page left intentionally blank; signature page follows*]

[*To insert signature blocks*.]

ANNEX A: DEFINITIONS AND ABBREVIATIONS

Part A: Definitions

Except as otherwise specified herein, or as the context may otherwise require, the following terms have the respective meanings set out below for all purposes of this Agreement:

"Abandonment" means either:

a. Developer demonstrates through statements, acts or omissions an intent not to perform, or continue to perform, a material part of the Work; or

b. the failure to perform a material part of the Work for a continuous period of 45 Calendar Days,

in each case unless such intention or failure is otherwise expressly permitted or excused pursuant to this Agreement.

"Acceptance" has the meaning given to it in Section 2.2.3.a and "Accept" and "Accepted" shall be similarly construed.

"Access Permit" means any Special Permit and any Utility Permit.

"Active Traffic Management" means real-time management of traffic using ITS and/or Variable Message Signs.

"Activity" means each task or sub-task that is identified by Developer as being necessary to complete the Construction Work and O&M Work During Construction, and that is included in the Project Schedule as a subcomponent of the Work Breakdown Structure.

"Additional Right-of-Way" means all Additional ROW Parcels held or acquired in the name of CDOT (or in such other name(s) as the Enterprises may otherwise determine in their discretion) pursuant to Section 7.3.1, but in each case with effect only from the Project License Start Date and only until the Project License End Date, in each case, for the relevant Additional ROW Parcel.

"Additional ROW Parcels" means each parcel of land that Developer proposes, at its discretion, to form part of the Additional Right-of-Way, and that subsequently becomes part of the Additional Right-of-Way, pursuant to Section 3.5 of Schedule 18 (*Right-of-Way*).

"Additional Survey Data" means any survey data other than the Supplied Survey Data.

"Additional Warranties" means those warranties that Developer is required to itself provide to the Department pursuant to Schedule 10 (*Design and Construction Requirements*).

"Affected Party" has the meaning given to it in the definition of Force Majeure Event in this Part A of Annex A (*Definitions and Abbreviations*).

"Affiliate" means, in relation to any Person:

a. any other Person having Control of that Person;

b. any other Person over whom that Person has Control; and

c. any Person over whom any other Person referred to in paragraph a. above also has Control.

"Age" means the elapsed time since an Element was first constructed or installed or if applicable, last reconstructed, rehabilitated, restored, renewed or replaced.

"Agreement" has the meaning given to it in the Preamble and, for certainty, includes this Annex A (*Definitions and Abbreviations*) and the Schedules pursuant to Section 2.4.1.

"Agreement Date" has the meaning given to it in the Preamble.

"Alternative Technical Concepts" means [ ][4] of the Proposal Extracts.

"Annual O&M Report" has the meaning given to it in Section 13.2 of Schedule 11 (*Operations and Maintenance Requirements*).

"Approval" has the meaning given to it in Section 2.2.3.b and "Approve" and "Approved" shall be similarly construed.

"As-Built" means the revised set of drawings, specifications, documents, data and surveys submitted by Developer and Accepted by the Department pursuant to Schedule 8 (*Project Administration*) and 10 (*Design and Construction Requirements*) and showing the exact dimensions, geometry, and location of completed Construction Work.

"Asset" means any physical asset used from time to time by Developer or a Subcontractor to perform its obligations under this Agreement or any Subcontract, including any:

a. Element;

b. land or buildings (whether or not part of or on the Site);

c. plant, machinery or equipment;

d. spare parts; and

e. tools.

"Asset Condition Inspections" means those inspections required to be conducted pursuant to Section 8 of Schedule 11 (*Operations and Maintenance Requirements*) to determine the condition of all Elements and to identify structural and non-structural deficiencies which may present a potential safety hazard.

[4] Cross-reference to be inserted prior to execution of this Agreement.

"Asset Condition Report"	means a report prepared by Developer pursuant to Section 3.5 of Schedule 12 (*Handback Requirements*).
"Authority Having Jurisdiction"	means CDOT.
"Automated Vehicle Locator (AVL) System"	means the system described in Section 12 of Schedule 11 (*Operations and Maintenance Requirements*).
"Automatic License Plate Recognition"	means a camera-based system used to obtain an image of a vehicle's license plate if a transponder is not detected.
"Automatic Traffic Recorder"	means a system that continuously collects vehicle volume and functional classification data using in-pavement loops and piezoelectric sensors.
"Automatic Vehicle Identification Reader"	means the system that is installed at each tolling point and used to read tag information stored inside each transponder.
"Available Insurance"	has the meaning given to it in Section 35.5.
"Average Daily Traffic"	means the average total traffic, in both directions, in one Calendar Day.
"Bare and Wet Pavement"	means when a minimum of 95% of the driving surface (edge line to edge line) including shoulders is free of snow, slush and/or ice.
"Base Case Equity IRR"	means the Preliminary Equity IRR, as updated pursuant to Schedule 1 (*Financial Close*).
"Base Financial Model"	means the financial model generated and computed by spreadsheet software as submitted in the Developer's Proposal, a copy of which is attached as Schedule 26 (*Base Financial Model*).
"Baseline Asset Condition Inspection Plan"	has the meaning given to it in Section 2.3.2 of Schedule 11 (*Operations and Maintenance Requirements*).
"Baseline Inspections"	has the meaning given to it in Section 2.3.1.a of Schedule 11 (*Operations and Maintenance Requirements*).
"Baseline Schedule"	means the logic-based Critical Path schedule for all Construction Work and all O&M Work During Construction which has been prepared by Developer based on the Proposal Schedule and Approved by the Enterprises pursuant to Section 3.3.4.a. of Schedule 8 (*Project Administration*).
"Baseline Substantial Completion Date"	means [ ][5], as such Baseline Substantial Completion Date may be extended from time to time pursuant to this Agreement as a result of: a. pursuant to Section 15.3.1.e.iii, a Supervening Event; or b. a Change.[6]

[5] Insert Baseline Substantial Completion Date from Form D-3 (Financing Plan Dates) of Preferred Proposer's Financial Proposal.
[6] The definition of the Baseline Substantial Completion Date may be amended at Financial Close if Financial Close occurs after March 31, 2017, which is the date assumed in the ITP. This amendment will be made at Financial Close pursuant to the terms of Schedule 1.

"BE" has the meaning given to it in the Preamble.

"BNSF" means BNSF Railway Company.

"BNSF Crossing" means the existing and/or proposed crossing by the BNSF Market Lead Railroad through the I-70 East corridor on the Right-of-Way as described in Section 10.1.4 of Schedule 10 (*Design and Construction Requirements*).

"BNSF RRA" means the railroad agreement between CDOT and BNSF dated [ ].

"BNSF Work" means all duties and services to be furnished and provided by BNSF as required by the BNSF RRA.

"Breakage Costs" means any prepayment premiums or penalties, make-whole payments or other prepayment amounts, including costs of early termination of interest rate and inflation rate hedging, swap, collar or cap arrangements, that Developer must pay, or that may be payable or credited to Developer, under any Financing Document or otherwise as a result of the payment, redemption, acceleration or reduction of all or any portion of the principal amount of Project Debt prior to its scheduled payment date, excluding, however, any such amounts included in the principal amount of any Refinancing.

"Calendar Day" means a calendar day as determined by reference to the time and date in Denver, Colorado, and "day" means any such calendar day.

"Calendar Year" means each consecutive period of 12 months commencing on January 1 and ending on December 31 as each such day shall be determined by reference to the time and date in Denver, Colorado.

"Category 1 Defect" means a Defect in an Element which causes or has the potential to cause any one or more of the following:

a. an immediate or imminent health or safety hazard, nuisance or other risk to Users or workers;

b. an immediate or imminent risk of structural failure of an Element;

c. an immediate or imminent risk of damage to a third party's property or equipment; or

d. an immediate or imminent risk of damage to the Environment.

"Category 2 Defect" means a Defect in an Element that is not a Category 1 Defect.

"CDOT" has the meaning given to it in the Preamble and, for certainty, refers to the Colorado Department of Transportation acting in its own capacity and not pursuant to a delegation of authority by the Enterprises pursuant to Section 18.1.2.a.

"CDOT Roadways" means I-270, I-225, Vasquez Boulevard, Colorado Boulevard and Quebec Street, in each case including the ramps up to the intersecting cross-

roadway (including directional island and free-flow turn lane where present).

"Change" [*To be provided in a subsequent Addendum.*]

"Change in Costs" [*To be provided in a subsequent Addendum.*]

"Change in Law" means the coming into effect after the Setting Date of:

a. the enactment, promulgation or adoption of any Law;

b. a binding change in the judicial or administrative interpretation of any Law; or

c. any modification (including repeal) of any Law,

in each case by a Governmental Authority that:

d. is materially different from or inconsistent with Law as in effect prior to the coming into effect of the relevant change as referenced in paragraphs a., b. or c. of this definition; and

e. was not (in the same or substantially similar form and substance to that which later comes into effect) pending, passed or adopted, including in the form of a bill or draft, as of the Setting Date,

provided that Change in Law shall exclude any such enactment, promulgation, adoption, change or modification of any (x) Federal Law, (y) State or local labor Law or (z) State or local tax Law of general applicability.

"Change of Control" means any direct or indirect Equity Transfer of interests in either Developer or any Equity Member that results in or could (upon the occurrence of any condition or exercise of any right or option) result in any change in the Person or Persons that has direct or indirect Control of Developer or such Equity Member, excluding:

a. any Permitted Equity Transfer; and

b. a bona fide open market transaction in securities effected on a recognized public stock exchange involving an initial public offering.

"Circuit Time for Plowing" means the total time required to fully service a designated Snow Route calculated from the time the plow vehicle leaves the yard to the time it has completed the plowing operation on the entire plow route.

"Circuit Time for Spreading" means the total time required to fully service a designated salt or liquid anti-icing/de-icing Snow Route calculated from the time the spreader vehicle leaves the yard to the time it completes the route.

"City of Denver" means the City and County of Denver, Colorado.

"Claim" means any claim, demand, action, cause of action, proceeding (legal or administrative), investigation, judgment, demand, suit, dispute or liability.

"Closed Circuit Television" means cameras used for monitoring travel conditions.

"Closure" means that all or part of any travel lane, ramp, cross street, shoulder, sidewalk or driveway within the O&M Limits is closed or blocked, or that the use thereof is otherwise restricted, for a period of any duration.

"Closure Deduction Period" means, in respect of any Non-Permitted Closure, each continuous period of 15 minutes commencing from and including the commencement time of such Non-Permitted Closure.

"Closure Default Event" means the occurrence of any of the following:[7]

a. during the Construction Period, the cumulative amount of Construction Closure Deductions accrued during:

   i. any rolling [12] month period equals or exceeds $[ ]; or

   ii. any rolling [36] month period equals or exceeds $[ ]; or

b. during the Operating Period, the cumulative amount of Operating Period Closure Deductions accrued during:

   i. any rolling [12] month period equals or exceeds $[ ] (indexed); or

   ii. any rolling [36] month period equals or exceeds $[ ] (indexed).

"Collateral Agent" means the financial institution designated by the Lenders to act as their trustee or agent pursuant to the Financing Documents.

"Command Control and Monitoring System" means the integrated overarching system required to monitor, control and implement the various fire, life safety, and other systems located in the Cover.

"Committed Investment" means:

a. any form of direct investment by Equity Members in Developer, including the purchase of equity shares in Developer;

b. any Equity Member Debt; or

c. any irrevocable on-demand letter of credit issued by an Eligible Financial Institution for the account of an Equity Member naming Developer as beneficiary and securing the provision of any direct investment or debt referenced

[7] Thresholds, including time periods, to be provided in a subsequent Addendum.

in paragraph a. of this definition.

"Compensable Event" has the meaning given to it in Section 15.7.a.

"Compensation Event" means:

a. any breach by the Enterprises of this Agreement, except to the extent such breach is a Compensation Event under any other paragraph of this definition:

b. any:

i. breach by the Enterprises of Sections 7.2.1.a or 7.2.1.b;

ii. failure by the Enterprises to provide Developer with Possession of any ROW Parcel by the applicable date specified in the "Date First Available for Possession" column in the table in Appendix A to Schedule 18 (*Right-of-Way*); or

iii. failure by the Enterprises to comply with their obligation to complete Property Management of certain ROW Parcels pursuant to Sections 2.2.2 and 2.2.3 of Schedule 18 (*Right-of-Way*);

c. any Discriminatory Change in Law;

d. the discovery of any Unexpected Geological Conditions;

e. any failure of CDOT to perform Department-Retained O&M Work in a manner that is generally consistent with its practice prior to the Setting Date;

f. any incident of physical damage to an Element of the Project caused by:

i. installation, testing or maintenance of any ETC or ITS Elements by the ETC System Integrator pursuant to the E-470 TSA; or

ii. the construction, operation or maintenance of any Other Department Project in the immediate vicinity of the Right-of-Way, but only to the extent not:

A. constructed, operated or maintained by either Developer or another Person under common Control with Developer; or

B. Known or Knowable;

g. any breach by the City of Denver of the Denver IGA that results in:

i. the assessment of fees or expenses on Developer (or any Subcontractor) that are waived or suspended by the City of Denver under Section 4.A.(i)-(iii) and Exhibit B of the Denver IGA; or

ii. the City of Denver not accepting the quantum of fill dirt specified in Section 4.D of the Denver IGA, provided that such fill dirt satisfies the requirements specified in such section and in Schedule 17 (*Environmental Requirements*);

h. any Enterprise Release of Hazardous Substances;

i. the issuance of any Safety Compliance Order, excluding any such order or part thereof that orders or directs Safety Compliance that Developer is otherwise obligated to implement pursuant to this Agreement;

j. any suspension by the Enterprises pursuant to Section 23.3.1 to the extent such suspension constitutes a Compensation Event pursuant to Section 23.3.2; or

k. any physically intrusive inspection conducted pursuant to Section 21.2.1 to the extent such inspection constitutes a Compensation Event pursuant to Section 21.2.2 or 21.2.3.b,

in each case (x) unless such event arises as a result of any breach of Law, Governmental Approval, Permit or this Agreement, fraud, willful misconduct, criminal conduct, recklessness, bad faith or negligence by or of any Developer-Related Entity and (y) excluding any such event that occurs prior to NTP1.

"Construction Closure Deduction" means, in respect of each full or partial Closure Deduction Period that commences in respect of:

a. any Non-Permitted Construction Closure on I-70 Mainline, I-270 or I-225, $5,000; or

b. any other Non-Permitted Construction Closure, $2,000.

"Construction Contract" means the contract for the performance of the Construction Work and of the O&M Work During Construction[8] entered into between Developer and the Construction Contractor in compliance with Section 17.[9]

"Construction Contractor" means the design and construction contractor engaged by Developer under the Construction Contract.

"Construction of Relocation Acceptance" means a letter in the form set out in Appendix D to Section 4 of

[8] To be amended to reflect contractual structure of Preferred Proposer.
[9] This defined term assumes that there will be a single such contract. This definition, and related provisions (including the definition of Construction Contractor), will be adjusted at the Enterprises' reasonable discretion to reflect any Proposal that proposes a different (but otherwise permissible or Enterprise approved) contracting arrangement.

Letter" or "CRAL" Schedule 10 (*Design and Construction Requirements*).

"Construction Period" means the period that begins on the earlier to occur of the date of issuance of NTP1 and the Financial Close Date and ends on (and including) the Substantial Completion Date.

"Construction Standards" means:

a. the standards and specifications listed in Schedule 10A (*Applicable Standards and Specifications*);

b. any other standards and specifications expressly referenced in this Agreement as applicable to the Construction Work (excluding, for certainty, any Laws, Governmental Approvals or Permits); and

c. any other standards and specifications that apply to the Construction Work (excluding, for certainty, any Laws, Governmental Approvals or Permits), including as a result of Developer's methods of performing the Construction Work,

in each case in the form published or otherwise in effect as of the Setting Date (subject to change, addition or replacement pursuant to Section 8.6).

"Construction Work" means all administrative, design, installation, compliance, permitting, support services, Utility Work, construction related obligations and all other tasks to be performed and provided by Developer required to comply with all requirements set out in Schedule 10 (*Design and Construction Requirements*) and any other provisions of this Agreement applicable to the performance of the Construction Work.

"Contract Drawings" means the documents included in Schedule 10B (*Contract Drawings*).

"Contract Year" means a period of twelve months commencing on (and including) July 1 of each Calendar Year, provided that:

a. the first Contract Year shall be the period commencing on (and including) the Agreement Date and ending on the immediately following June 30; and

b. the final Contract Year shall be the period commencing on (and including) July 1 immediately preceding the last Calendar Day of the Term and ending on that last Calendar Day of the Term,

where each of June 30 and July 1 shall be determined by reference to the time and date in Denver, Colorado.

"Contractor Bond" means any payment and/or performance bonds either in the form set out in Schedule 20 (*Forms of Contractor Bonds*) (or in such other form, including a letter of credit from an Eligible Financial Institution, as may be Approved by the Enterprises), which bonds or other instruments shall be:

a. provided by and maintained with an Eligible Surety (or, as

applicable, an Eligible Financial Institution):

b. in a penal amount of not less than:

i. with respect to any bond (or other instrument) delivered pursuant to Section 9.3.1.a.i, 50% of the aggregate value of the Construction Work and the O&M Work During Construction to be performed under the Principal Subcontracts;

ii. with respect to any bond (or other instrument) delivered pursuant to Section 9.3.1.a.ii, $50,000,000 (indexed); and

iii. with respect to any bond (or other instrument) delivered pursuant to Section 9.3.1.a.iii, 100% of the maximum amount payable by Developer to the O&M Contractor under the O&M Contract in the then current Contract Year,

or, in any case, if greater or with respect to any other part of the Work, the minimum required by Law, including C.R.S. § 38-26-106; and

c. otherwise provided in compliance with Section 9.3.1.

"Control" of a Person by another Person means that other Person (whether directly or indirectly):[10]

a. holds at least [ ]% or more of the equity interests in such Person;

b. has the right to appoint, approve or remove at least [ ]% of the board of directors (or equivalent) of such Person; or

c. exercises control over the direction of the business, management and/or policies of such Person, including, in the Enterprises' reasonable determination, through:

i. preferred or minority equity holder veto or voting rights (whether such rights are provided by Law or by such Person's organizational documents or related member or shareholder agreements or similar agreements); or

ii. any other means,

to the extent such rights or other means circumvent, or appear intended to circumvent, any restrictions or obligations that would otherwise arise if this definition of Control applied.

[10] Definition of Change of Control to be tailored based on structure of Preferred Proposer, noting that the primary intention would be to restrict changes in material initial shareholders (whatever their initial shareholding percentage (including if less than 50%)) rather than to restrict changes in "majority control".

"Control Center"	means Developer's control center for controlling the Cover MEP Systems.
"Controlling Equity Member"	means any Equity Member that has Control of Developer.
"Controlling Work Item"	means the Activity or work item on the Critical Path having the least amount of Float.
"CORA"	means the Colorado Open Records Act.
"CORA Exempt Materials"	means any trade secrets, privileged information and confidential commercial, financial, geological or geophysical data exempt from public disclosure under C.R.S. §§ 24-72-204(3)(a)(IV) or information that is otherwise exempt from disclosure under CORA.
"Core Proposer Team Member"	has the meaning given to it in the ITP.
"Correction"	means action taken to eliminate Nonconforming Work detected in the Work.
"Corrective Action"	means the action taken by which the Nonconforming Work is made compliant with the Agreement.
"Corrective Action Plan"	means Developer's plan for taking Corrective Action in respect of Nonconforming Work.
"Courtesy Patrol Service Plan"	means the plan referred to in Section 9.2.2.c of Schedule 11 (*Operations and Maintenance Requirements*).
"Cover"	means the Elements to be constructed by Developer within the limits depicted in the Conceptual Master Plan Exhibit in Schedule 10B (*Contract Drawings*).
"Cover Maintainer"	[ ].[11]
"Cover MEP System"	means the mechanical, electrical, and plumbing system required for the Cover.
"CP Deduction Month"	has the meaning given to it in Section 1(a) of Part 1 of Schedule 6 (*Performance Mechanism*).
"CPI"	means the Consumer Price Index All items (BES Series ID CUUR0000SA), as published by the United States Department of Labor. Bureau of Labor Statistics, for which the base year is 1982-84 = 100, or if such publication ceases to be in existence, a comparable index selected by the Enterprises and approved by Developer, acting reasonably, provided that: a. if the CPI is revised so that the base year differs from that set out above, the CPI shall be converted in accordance with the conversion factor published by the United States Department of Labor, Bureau of Labor Statistics; and

[11] The entity that will be responsible for maintenance of the Cover will be identified in a subsequent Addendum.

b. if the Bureau of Labor Statistics otherwise alters its method of calculating such index, the Parties shall mutually determine appropriate adjustments in the affected index.

"Critical Path" means the longest sequence, in terms of time, of logically connected Activities on the Project Schedule ending with Final Acceptance.

"Critical Path Method" means the scheduling technique showing all Activities required to complete a task, complete with durations and relationships between Activities.

"Critical Velocity" means the minimum longitudinal air velocity required to prevent backflow of smoke, and which is a function of tunnel geometry and design fire characteristics.

"Cross Drain" means pipes or culverts that convey water without interruption from one side of a road to the other.

"Cure Period" means, for any Noncompliance Event, the "Cure Period" (if any) specified for such Noncompliance Event in Table 6A.1 or Table 6A.2, as applicable, which shall commence on and from the Noncompliance Start Time of such Noncompliance Event.

"Default Interest" means interest accruing at the Default Interest Rate on a payment that is due but unpaid.

"Default Interest Rate" means, for each Calendar Day during which Default Interest accrues pursuant to this Agreement, the rate per annum equal to the 30 Calendar Day British Bankers Association LIBOR Rate ("BBA LIBOR"), as published by Reuters (or other commercially available source providing quotations of BBA LIBOR as designated by the Enterprises from time to time) at approximately 11:00 a.m., London time for Dollar deposits (for delivery on the first Calendar Day on which Default Interest is due) plus 200 basis points, provided that if such rate is not available at such time for any reason, then the "Default Interest" rate shall be the rate per annum determined by the Enterprises as provided by a similar organization.

"Defect" means a defect, howsoever caused, affecting the condition, use, functionality or operation of any Element, including such defects which would cause or have the potential to cause any one or more of the following:

a. a hazard, nuisance or other risk to public or worker health or safety, including the health and safety of Users;

b. a structural deterioration of the affected Element or any other part of the Project;

c. damage to a third party's property or equipment;

d. damage to the Environment;

e. failure of an Element or any part of an Element to comply with the applicable General Requirement or any other

requirement set out in this Agreement; or

f. failure of an Element to meet or exceed the Target for the applicable Measurement Criteria.

"Defect Remedy Period" means:

a. for a 'Category 1' Defect, the maximum time period for taking and completing the action required by:

i. Section 4.2.2 of Schedule 11 (*Operations and Maintenance Requirements*), being the time period set out in the column headed "Cat 1 Immediate Action" in the Performance and Measurement Tables; or

ii. Section 4.2.3 of Schedule 11 (*Operations and Maintenance Requirements*), being the time period set out in the column headed "Cat 1 Permanent Remedy" in the Performance and Measurement Tables; or

b. for a 'Category 2' Defect, the maximum time period for taking and completing the action required by Section 4.2.4 of Schedule 11 (*Operations and Maintenance Requirements*), being the time period set out in the column headed "Cat 2 Permanent Repair" in the Performance and Measurement Tables,

in each instance commencing from the time that Developer first becomes (or should have become) aware of the existence of the relevant Defect.

"Deferred Compensation" has the meaning given to it in Section 15.4.c.

"Deliverable" means any document, drawing, report, plan, calculation, application, data, work product or other material or information, regardless of form, and including any draft, required pursuant to this Agreement to be submitted or resubmitted to the Enterprises or the Department, as applicable, for Approval, Acceptance, any other consent, approval or like assent, or Information, excluding, for certainty, notices and correspondence.

"Denver IGA" means the Intergovernmental Agreement among CDOT, HPTE, BE and the City of Denver dated as of September 14, 2015.

"Department" means:

a. CDOT acting pursuant to a delegation of authority by the Enterprises pursuant to Section 18.1.2.a; or

b. the Enterprises, but only if and to the extent that:

i. the context may require; or

ii. the Enterprises otherwise notify Developer.

"Department Office" means the office space and equipment provided by Developer for Department personnel pursuant to Section 11.1.5 of Schedule 8 (*Project Administration*).

"Department Provided Approvals" means:

a. each of the Governmental Approvals listed in Table 9-1 in Section 9.5.15 of Schedule 10 (*Design and Construction Requirements*);

b. each of the Governmental Approvals listed in Table 17-1 of Schedule 17 (*Environmental Requirements*); and

c. the Interstate Access Request identified in the Reference Documents.

"Department-Retained O&M Work" means:

a. Renewal Work of the I-70 Mainline and associated infrastructure from the I-25/I-70 interchange to I-70 Brighton Boulevard interchange and from I-70 Chambers Road interchange to I-70 Tower Road interchange, in each case within the limits depicted on the O&M Limits;

b. operation and maintenance of any ETC or ITS elements not to be maintained by Developer or the ETC System Integrator pursuant to Appendix B to Section 3 of Schedule 10 (*Design and Construction Requirements*); and

c. Snow and Ice Control Services until, but not including, the date of issuance of NTP3.

"Design of Relocation Acceptance Letter" or "DRAL" means a letter in the form set out in Appendix C to Section 4 of Schedule 10 (*Design and Construction Requirements*).

"Deterioration Fraction" has the meaning set out in Section 4.3.a of Schedule 12 (*Handback Requirements*).

"Developer" has the meaning given to it in the Preamble.

"Developer Change" means a Change proposed by Developer pursuant to Section 14.1.b.

"Developer Change Notice" has the meaning given to it in Section 14.1.b.

"Developer Default" has the meaning given to it in Section 32.1.1.

"Developer Default Cure Period" has the meaning given to it in Section 32.1.1.

"Developer-Related Entities" means:

a. Developer;

b. the Equity Members;

c. Subcontractors (of any tier);

d. any other Persons (except, for certainty, the Enterprises) performing any of the Work for or on behalf of Developer;

e. any other Persons (except, for certainty, the Enterprises) for whom Developer may be legally or contractually responsible; and

f. the employees, agents, officers, directors, representatives and consultants of any of the foregoing.

"Developer Release of Hazardous Substances" means all Releases of Hazardous Substances onto the Site caused or exacerbated by Developer or any other Developer-Related Entity.

"Developer Retained Expansion" means any Other Department Project, or other facility, constructed by a Person other than Developer, that the Enterprises require Developer to operate and/or maintain pursuant to this Agreement, including pursuant to an Enterprise Change.

"Developer-risk Permit Area" means any Permit Area:

a. which is adjacent to the Additional Right-of-Way but not the Right-of-Way; and/or

b. for which access and/or use is required to be procured by Developer pursuant to a Permit for which Developer bears all risk of delay and/or all risk of increased cost pursuant to Section 8.4.3.b.

"Developer's Representative" has the meaning given to it in Section 18.2.1.a.

"Disadvantaged Business Enterprise" [*To be provided in a subsequent Addendum.*]

"Discriminatory Change in Law" means a Change in Law, the terms of which expressly apply to:

a. the Project and not to similar projects; and/or

b. Developer and not to other Persons (unless such Persons are public-private partnership project developers engaged in projects similar to the Project (and in roles similar to Developer on such projects)),

in each case excluding any Change in Law that is made in response to any breach of Law, Governmental Approval, Permit or this Agreement, or fraud, willful misconduct, criminal conduct, recklessness, bad faith or negligence of any Developer-Related Entity.

"Dispute"	means any dispute between the Enterprises and Developer arising out of or in connection with this Agreement.
"Dispute Resolution Procedures"	means the procedures for the resolution of Disputes set out in Section 38 and Schedule 25 (*Dispute Resolution Procedures*).
"Distribution"	means, whether in cash or in kind any: a. dividend or other distribution in respect of share capital (or the equivalent); b. reduction of capital, redemption or purchase of shares or any other reorganization or variation to share capital; c. payments by Developer under any Equity Member Funding Agreements (whether of principal, interest, Breakage Costs or otherwise); d. payment, loan, contractual arrangement or transfer of assets or rights to the extent (in each case) was neither in the ordinary course of business nor on reasonable commercial terms; or e. the receipt of any other benefit that is not received in the ordinary course of business and on reasonable commercial terms.
"Document Control System"	means the system established and maintained by Developer pursuant to Section 13.1.1 of Schedule 8 (*Project Administration*).
"DRIR"	means the Denver Rock Island Railroad.
"DRIR Crossing"	means the existing and/or proposed crossing by the DRIR Railroad through the I-70 East corridor on the Right-of-Way as described in Section 10.1.5 of Schedule 10 (*Design and Construction Requirements*).
"DRIR RRA"	means the railroad agreement between CDOT and DRIR dated [ ].
"DRIR Work"	means all duties and services to be furnished and provided by the DRIR as required by the DRIR RRA.
"Drop Site"	has the meaning given to it in Section 1.2 B of Appendix B of Schedule 11 (*Operations and Maintenance Requirements*).
"DRTL"	has the meaning given to it in Section 6 of Schedule 9 (*Submittals*).
"Durability Plan"	means the Developer's plan addressing the durability of all Residual Elements prepared and updated in accordance with Schedule 8 (*Project Administration*).
"E-470 TSA"	means the tolling services agreement between HPTE and the ETC System Integrator dated May 7, 2015.
"ECMTP"	has the meaning given to it in Section 17.4 of Schedule 17 (*Environmental*

Requirements).

"ECWP" has the meaning given to it in Section 17.2 of Schedule 17 (*Environmental Requirements*).

"Electronic Toll Collection System" means the barrier free, non-cash road charging system, including all signage, civil and telecommunications infrastructure and back-office facilities, that allows free-flow movement for I-70 Mainline users to enter and exit the Tolled Express Lanes without having to stop to pay cash tolls.

"Element" means an individual component, system or subsystem of the Project, and shall, in relation to O&M Work, include at a minimum a breakdown into the items described in the column headed "Element" in the Performance Requirements (as such items are further subdivided into subsections where appropriate).

"Eligible Financial Institution" means a bank or financial institution:

a. having an office in Denver, Colorado or New York, New York at which a letter of credit issued by it can be presented for payment by hand delivery, electronic means or fax; and

b. having a Minimum Issuer Rating from at least two Rating Agencies,

where for purposes of this definition "Minimum Issuer Rating" means a long-term unsecured debt rating of at least:

i. "A-" by Standard & Poor's Ratings Services;

ii. "A-" by Fitch, Inc.;

iii. "A3" by Moody's Investors Service, Inc.; or

iv. "A low" by DBRS, Inc.,

in each case with an outlook of "stable" or better.

"Eligible Surety" means a surety authorized to issue bonds in the State having either:

a. a Minimum Eligible Surety Rating from at least two Rating Agencies; or

b. a rating of at least "A-" and "Class VIII" from A.M. Best Company, Inc. (but only if it is at the relevant time a Registered Rating Agency),

where for purposes of this definition "Minimum Eligible Surety Rating" means a long-term unsecured debt rating of at least:

i. "A" by Standard & Poor's Rating Services;

ii. "A" by Fitch, Inc.;

iii. "A2" by Moody's Investors Service, Inc.; or

iv. "A" by DBRS, Inc.,

in each case with an outlook of "stable" or better.

"Emergency" means any unforeseeable event affecting the Project, whether directly or indirectly, that:

a. is an immediate or imminent threat, or, if not promptly addressed, a potential threat, to the safety of the public;

b. causes disruption or, if not promptly addressed, has the potential to cause disruption, to the free flow of traffic on or about the Project;

c. is an immediate or imminent threat to the long term integrity of any part of the infrastructure of the Project, to the Environment or to property adjacent to the Project;

d. is recognized by the Enterprises or CDOT as an emergency pursuant to Fiscal Rule 2-2 of the State of Colorado Fiscal Rules; or

e. is recognized or declared as an emergency by the Governor of the State, FEMA, the U.S. Department of Homeland Security or any other Governmental Authority with legal authority to recognize or declare an emergency.

"Emergency Repair Work" has the meaning given to it in Section 8.3.4.a.

"Emergency Services" means any Federal, State or local police, fire, emergency or other public safety Governmental Authorities (including the National Guard), and any other security or emergency personnel acting at the direction of any Governmental Authority.

"Emerging Small Businesses" [*To be provided in a subsequent Addendum.*]

"Encumbrance" means any mortgage, pledge, hypothecation, deed of trust, mortgage, security interest, lien, financing statement, charge, option, assignment or encumbrance of any kind or any arrangement to provide priority or preference, including any easement, right-of-way, restriction (whether on voting, sale, transfer, disposition, use or otherwise), right, lease and other encumbrance on title to real or personal property (whether or not of record), whether voluntary or imposed by Law, and any agreement to give any of the foregoing.

"Enterprises" has the meaning given to it in the Preamble.

"Enterprise Change" means a change proposed by Developer pursuant to Section 14.1.a.

"Enterprise Change Notice" has the meaning given to it in Section 14.1.a.

"Enterprise Default" has the meaning given to it in Section 32.3.1.

"Enterprise Default Cure Period" has the meaning given to it in Section 32.3.1.

"Enterprise Release of Hazardous Substances" means any Release of Hazardous Substances on, in, under, from or in the vicinity of the Right-of-Way or any Additional Right-of-Way caused by the Enterprises or CDOT, which Release:

a. occurs:

i. with respect to any ROW Parcel, after the Setting Date; and

ii. with respect to any Additional ROW Parcel, on or after its Project License Start Date; and

b. is required to be managed or remediated pursuant to either Law or Developer's obligations under this Agreement.

"Enterprise Representative" has the meaning given to it in Section 18.2.1.a.

"Environment" means air, soils, submerged lands, surface waters (including wetlands), groundwaters, land, stream sediments, surface or subsurface strata, biological resources, including endangered, threatened and sensitive species, natural systems, including ecosystems, historic, archeological and paleontological resources, improvements, including buildings, sewer and septic systems, storm drains, publicly owned treatment works, and waste treatment, storage or disposal systems.

"Environmental Approval" means the FEIS, the ROD, the Reevaluation and any Governmental Approval required for the Project or the Work pursuant to Environmental Law.

"Environmental Law" means any Law applicable to the Project or the Work requiring consideration of impacts on the Environment or addressing, regulating or imposing liability, actions or standards of conduct that pertains to the Environment, Hazardous Substances, contamination of any type whatsoever, or environmental health and safety matters, and any lawful requirements and standards that pertain to the Environment, Hazardous Substances, contamination of any type whatsoever, or environmental health and safety matters, set out in any permits, licenses, approvals, plans, rules, regulations, administrative or judicial orders, ordinances or other Governmental Approvals adopted, or other criteria and guidelines promulgated, pursuant to such Law, including in each case those relating to:

a. the manufacture, processing, use, distribution, existence, treatment, storage. disposal, generation, transportation and Release of Hazardous Substances;

b. protection of wildlife, animal or plant species listed as threatened or endangered under and subject to an

applicable threatened or endangered species Law, species, other sensitive species, wetlands, water courses and water bodies, antiquities, fossils, coins, articles of value, precious minerals, cultural artifacts, human burial sites and remains and other similar remains of archaeological, cultural or paleontological interest, natural resources, and of the Environment generally;

c. the operation and closure of underground storage tanks;

d. human health and safety; and

e. notification documentation and record keeping requirements relating to the foregoing.

"Environmental Requirements" means the requirements set out in Schedule 17 (*Environmental Requirements*), including the obligation to comply with Environmental Law and all Environmental Approvals.

"Equity IRR" means, as of any date of calculation, the nominal post-tax internal rate of return on the total amount of Committed Investment described in paragraphs a. and b. of the definition of Committed Investment made and projected, as of such date, to be made over the full Term, which rate of return shall be calculated, using the Base Financial Model, as the discount rate that, when applied to the equity cash flows calculated as of the relevant date, results in a net present value of zero. For purposes of this definition:

a. the phrase "post-tax" refers only to U.S. Federal and state income tax liability of Developer or its Equity Members, calculated at no greater than the maximum rate charged to domestic corporations and taking into account the deductibility of state and local taxes for Federal purposes, and specifically excludes:

i. any foreign income tax and other tax of any kind; and

ii. any withholding tax for Federal state or local purposes, including any tax that Developer or an Equity Member is obligated to withhold on Distributions (whether actual or constructive) or other payments or allocations to Equity Members or holders of debt of or equity interests in an Equity Member under 26 U.S.C. §§ 1441–1446, notwithstanding 26 U.S.C. § 1461;

b. the phrase "equity cash flows" refers to:

i. the total amount of Distributions that, as of the date of calculation, have been made and are projected to be made during the Term, minus:

ii. the total amount of Investment described in paragraphs a. and b. of the definition of

Committed Investment that, as of the date of calculation, has been made and is projected to be made during the Term; and

c. the Equity IRR as of the Financial Close Date is equal to the Base Case Equity IRR.

"Equity Member" means any Person with a direct equity interest in Developer.

"Equity Member Debt" means any bona fide indebtedness of Developer for borrowed money that:

a. is held by any Equity Member or an Affiliate thereof; and

b. is subordinated in priority of payment and security to all Project Debt held by Persons who are not Equity Members.

"Equity Member Funding Agreement" means any loan agreement, credit agreement or other similar financing agreement or subordination agreement providing for or evidencing Equity Member Debt.

"Equity Transfer" means:

a. any sale, transfer, assignment, conveyance, or other disposal of any direct or indirect legal, beneficial or equitable ownership interests in a Person; or

b. any agreement, whether or not subject to the occurrence of any condition or exercise of any right or option, to effect any transaction specified in paragraph a. of this definition, including any pledge, mortgage, grant of any security interest, lien or other encumbrance.

"Escrow Agent" means the escrow agent appointed by the Parties pursuant to the Financial Model Escrow Agreement.

"ETC System Integrator" means the E-470 Public Highway Authority, a political subdivision of the State formed under the Public Highway Authority Law, Part 5 of Article 4 of Title 23, Colorado Revised Statutes.

"Exclusion" has the meaning given to it in Developer Default numbered (11) in Section 32.1.1.

"Excused Closure" means:

a. any Closure arising as a direct result of:

i. a Compensation Event;

ii. a Relief Event;

iii. an Emergency;

b. any Closure under the control of the Emergency Services;

c. any Closure that:

i. was previously under the control of the Emergency Services; and

ii. continues to subsist after the Emergency Services have returned operational control of all parts of the Project affected by such Closure to Developer, provided that, if any such Closure continues to subsist for a period in excess of 30 minutes after such control has been returned to Developer, any such excess period shall not be an Excused Closure; or

d. any Closure expressly ordered by, and continuing only for so long as ordered by, the Enterprises, CDOT or any Governmental Authority;

but only to the extent that, in the case of any such Closure:

e. such Closure does not arise as a result of:

i. any breach of Law, Governmental Approval, Permit or this Agreement, fraud, willful misconduct, criminal conduct, recklessness, bad faith or negligence by or of any Developer-Related Entity; or

ii. any risk that Developer is required to insure against pursuant to the terms of this Agreement; and

f. Developer is using its Reasonable Efforts to:

i. mitigate the impact of the relevant Closure;

ii. reopen the affected part(s) of the Project as quickly as possible to traffic; and

iii. if such Closure arose as the direct result of an Emergency, respond to the Emergency in accordance with the requirements of this Agreement.

"Exempt Refinancing" means:

a. any Refinancing that was fully and specifically identified and taken into account in the Base Financial Model and calculation of the Base Case Equity IRR and that, at the time of Refinancing, does not lead to a Refinancing Gain greater than zero;

b. amendments, modifications, supplements or consents to Funding Agreements and Security Documents, excluding extensions and renewals, and the exercise by a Lender of rights, waivers, consents and similar actions in the

ordinary course of day-to-day loan administration and supervision that do not individually or in the aggregate provide a financial benefit to Developer;

c. any changes in taxation or Developer's accounting treatment or policies; and

d. any of the following acts by a Lender of senior lien priority Project Debt:

i. the syndication of any of such Lender's rights and interests in the senior Funding Agreements;

ii. the grant by such Lender of any rights of participation, or the disposition by such Lender of any of its rights or interests, in respect of the senior Funding Agreements in favor of any other Lender of senior lien Project Debt or any other investor; or

iii. the grant by such Lender of any other form of benefit or interest in either the senior Funding Agreements or the revenues or assets of Developer;

whether by way of security or otherwise, in favor of any other Lender of senior lien Project Debt or any investor.

e. any amendment, variation, or supplement of any Financing Document in connection with the funding of the financing of Deferred Compensation pursuant to Section 15.5;

f. a reset of an interest rate and/or mandatory tender pursuant to the express terms of any Financing Documents; or

g. any sale of any equity interests in Developer by an Equity Member or securitization of the existing rights and/or interests attaching to any equity interests in Developer or any of its Equity Members, if any.

"Exit Zone" means the length of roadway between the Interior Zone and the exit Portal and which has variable illumination based upon the scene luminance exiting the Portal.

"Expiry Date" means the 30th anniversary of the Baseline Substantial Completion Date.

"Federal Law" means all Law of the Federal government of the United States of America.

"FEIS" has the meaning given to it in the Recitals.

"FEMA" means the Federal Emergency Management Administration.

"FHWA"	has the meaning given to it in the Recitals.
"Final Acceptance"	means the satisfaction of all Final Acceptance Conditions, as confirmed by the Enterprises' issuance of the Final Acceptance Certificate.
"Final Acceptance Certificate"	[*To be provided in a subsequent Addendum.*]
"Final Acceptance Conditions"	[*To be provided in a subsequent Addendum.*]
"Final Acceptance Date"	[*To be provided in a subsequent Addendum.*]
"Final Acceptance Deadline Date"	means the date which is 120 Calendar Days after the Substantial Completion Date, as such deadline may be extended from time to time as a result of: a. pursuant to Section 15.3.1.e.v, a Supervening Event; or b. a Change.
"Final Handback Inspection Report"	means the report prepared by Developer in accordance with Section 3.12 of Schedule 12 (*Handback Requirements*).
"Final Payment Month"	means the final month that commences during the Operating Period.
"Final Warning Notice"	has the meaning given to it in Section 26.2.2.
"Financial Close"	[*To be defined by reference to Schedule 1 in a subsequent Addendum.*]
"Financial Close Date"	means the date on which Financial Close occurs.
"Financial Close Deadline Date"	means [ ].[12]
"Financial Close Security"	means: a. one or more letters of credit issued by an Eligible Financial Institution delivered by Developer pursuant to Section 7.3.1.f of Part C of the ITP on or prior to the Agreement Date; and b. any replacement letter of credit delivered pursuant to Schedule 1 (*Financial Close*) that is issued by an Eligible Financial Institution in the same form as the letter of credit delivered pursuant to the ITP or otherwise in such other form as the Procuring Authorities may Approve.
"Financial Model"	means the updated Base Financial Model delivered by Developer pursuant to Schedule 1 (*Financial Close*), as subsequently replaced from time to time pursuant to Section 28.6 or Section 29.2.3.
"Financial Model Escrow	means the Financial Model Escrow Agreement executed by the Parties

[12] 60 days after the Agreement Date, or such later date as the Enterprises may determine (but not later than the date of expiration date of the Financial Close Security).

Agreement" and [ ] as Escrow Agent in substantially the form of Schedule 23 (*Form of Financial Model Escrow Agreement*) pursuant to Schedule 1 (*Financial Close*) or any replacement agreement entered into by the Parties.

"Financing Agreements" means:

a. the documents listed in the Lenders Direct Agreement[13], executed on or about the Financial Close Date;

b. any other loan or credit agreement, trust indenture, hedging agreement, interest rate swap agreement or other agreement by, with or in favor of any Lender pertaining to Project Debt (including any Refinancing), other than Security Documents;

c. any note, bond or other negotiable or non-negotiable instrument evidencing the indebtedness of Developer for Project Debt (including any Refinancing); and

d. any amendment, supplement, variation or waiver of any of the foregoing agreements or instruments.

"Financing Costs" means, in respect of any Substantial Completion Delay Period, the aggregate of:

a. all amounts of principal that will fall due for payment with respect to the Long Term Project Debt under the Financing Documents during such period;

b. all amounts (excluding default interest) of interest that will accrue under the Financing Documents with respect to the Project Debt during such period; and

c. reasonable financing fees and expenses that accrue during such period with respect to the Project Debt in connection with any of the foregoing,

in each case net of any reserves previously set aside under such Financing Documents with respect to payment of any amounts under such circumstances.

"Financing Documents" means the Financing Agreements and the Security Documents.

"First Payment Month" means the month referred to in paragraph b. of the definition of Payment Month in this Part A of Annex A (*Definitions and Abbreviations*).

"Float" means the amount of time that any given Activity or logically connected sequence of Activities shown on the Project Schedule may be delayed before it delays the occurrence of the Substantial Completion Date or Final Acceptance Date, where such Float is identified as the amount of time between the early start date and the late start date, or the early finish date and the late finish date, for each and every Activity shown on the Project Schedule.

[13] These documents will evidence senior debt and TIFIA debt only.

"Force Majeure Event" means the occurrence after the Agreement Date of:

a. war, civil war, invasion or armed conflict;

b. an act of terrorism or sabotage;

c. nuclear, chemical or biological contamination, excluding such contamination:

i. which is comprised of Hazardous Substances or Endangered Species; or

ii. the source or cause of which is the result of any actions of, inaction by, or breach of contract or Law by, the Affected Party; or

d. any blockade or embargo,

that directly prevents or delays either Party (the "Affected Party") from performing all or a material part of its obligations under this Agreement.

"GAAP" means Generally Accepted Accounting Principles in the US as in effect from time to time.

"General Purpose Lane" means a non-tolled travel lane on the I-70 Mainline within the O&M Limits.

"General Requirements" means the requirements set out in the column headed "General Requirement" in the Performance and Measurement Tables.

"Good Industry Practice" means that degree of skill, care, prudence, foresight and practice which would reasonably and ordinarily be expected from time to time of a skilled and experienced professional designer, engineer, constructor, maintainer or operator, as applicable, engaged in the same type of activity as that of Developer, or any other Person to which such term relates, seeking to comply with all Law and the same obligations and responsibilities as the obligations of Developer under this Agreement and/or the obligations and responsibilities of such Person under the same or similar circumstances.

"Governmental Approval" means any approval, authorization, certification, consent, decision, exemption, filing, license, permit, agreement, concession, grant, franchise, registration or ruling issued, granted or required by or with any Governmental Authority (excluding, for certainty, any Public Utility or Railroad) for the performance of any of Developer's obligations under this Agreement.

"Governmental Authority" means any:

a. Federal, State or local government, and any political subdivision of any of them;

b. any interstate, governmental, quasi-governmental, judicial, public, regulatory or statutory instrumentality, administrative agency, authority, body or entity of, or

formed by, any such government or subdivision thereof,

in each case other than the Enterprises.

"Grace Period" means, subject to Section 1.2(b)(i) of Part 6 of Schedule 6 (*Performance Mechanism*), for any Noncompliance Event, the "Grace Period" (if any) specified for such Noncompliance Event in Table 6A.1 or Table 6A.2, as applicable, which period shall commence on and from the Noncompliance Start Time of such Noncompliance Event and shall end at the same time of day as such Noncompliance Start Time on the day which is the number of days specified as the "Grace Period" for such Noncompliance Event after the day on which such Noncompliance Start Time occurs.

"Guarantor" means any parent company guarantor of a Principal Subcontractor's obligations under its Principal Subcontract.[14]

"Handback Certificate" has the meaning given to it in Section 3.12.d of Schedule 12 (*Handback Requirements*).

"Handback Deliverable" means any of the following:

a. the Handback Schedule;

b. the Residual Life Methodology Report;

c. each Asset Condition Report;

d. the Initial Handback Inspection Report;

e. the initial calculation of the Handback Reserve Amount;

f. the Second Handback Inspection Report;

g. the second calculation of the Handback Reserve Amount;

h. the Third Handback Inspection Report;

i. the third calculation of the Handback Reserve Amount; and

j. the Final Handback Inspection Report.

"Handback Inspections" means inspections carried out pursuant to Sections 3.7, 3.10 and 3.12.a of Schedule 12, in accordance with the requirements of Section 3.6 of Schedule 12 (*Handback Requirements*).

"Handback Inspection Reports" means the Initial Handback Inspection Report, the Second Handback Inspection Report, the Third Handback Inspection Report, and the Final Handback Inspection Report.

"Handback Letter of Credit" has the meaning given to it in Section 4.5.a of Schedule 12 (*Handback Requirements*).

[14] Definition subject to revision based on the Preferred Proposer's Proposal and contracting structure, as well as the prior identification of any Financially Responsible Parties under the terms of the RFQ and ITP.

"Handback Period" means the period beginning on the date which is 34 Calendar Months before the Expiry Date.

"Handback Renewal Elements Amount" has the meaning given to it in Section 4.3.a of Schedule 12 (*Handback Requirements*).

"Handback Requirements" means the requirements set out in Section 1 of Schedule 12 (*Handback Requirements*).

"Handback Reserve Account" has the meaning given to it in Section 4.1 of Schedule 12 (*Handback Requirements*).

"Handback Reserve Amount" means the sum of:

a. the Handback Renewal Elements Amount;

b. the Handback Residual Elements Amount; and

c. the estimated costs of performing any other Handback Work necessary to meet the Handback Requirements,

in each case as determined in accordance with Sections 4.2 and 4.3 of Schedule 12 (*Handback Requirements*).

"Handback Residual Elements Amount" has the meaning given to it in Section 4.3.b of Schedule 12 (*Handback Requirements*).

"Handback Schedule" means the schedule prepared by Developer in accordance with Section 3.2 of Schedule 12 (*Handback Requirements*).

"Handback Work" has the meaning given to it in Section 3.7.a. of Schedule 12 (*Handback Requirements*).

"Handback Work Period" means the period beginning on the date which is 58 Calendar Months before the Expiry Date.

"Handback Work Schedule" has the meaning given to it in Section 3.8.b.v. of Schedule 12 (*Handback Requirements*).

"Hazardous Substances" means any of the following:

a. any substance, product, waste or other material of any nature whatsoever which is or becomes listed, regulated, or addressed pursuant to Environmental Law;

b. any substance, product, waste or other material of any nature whatsoever that exceeds maximum allowable concentrations for elemental metals, organic compounds or inorganic compounds for the protection of human health and safety and/or the Environment, as defined by any Environmental Law;

c. any substance, product, waste or other material of any nature whatsoever which may give rise to liability pursuant to Environmental Law, as defined by any

Environmental Law, or under any statutory or common law theory based on negligence, trespass, intentional tort, nuisance or strict liability or under any reported decisions of a State or Federal court;

d. petroleum or crude oil excluding *de minimis* amounts and excluding petroleum and petroleum products contained within regularly operated motor vehicles, and

e. asbestos or asbestos-containing materials.

"High Occupancy Vehicle" means a vehicle occupied by more than two persons.

"Holiday" means any Calendar Day that is declared or considered to be a holiday pursuant to C.R.S. 24-11-101(1)-(2).

"HPTE" has the meaning given to it in the Preamble.

"IAA" means the Intra-agency Agreement among BE, HPTE and CDOT dated as of [ ].

"I-70 East EIS" means all versions of the NEPA documentation for the Project, including draft, supplemental draft and final environmental impact statements.

"I-70 Mainline" means Interstate 70, including the Tolled Express Lanes, General Purpose Lanes, auxiliary lanes, buffers, enforcement areas, shoulders, ramps up to the intersecting cross-roadway (including directional island and free-flow turn lane where present) and associated collector-distributor roads.

"Incident" means any event that impedes the normal flow of traffic.

"Incident Response Plan" has the meaning given to it in Section 9.4 of Schedule 11 (*Operations and Maintenance Requirements*).

"Incidental Utility Work" has the meaning given to it in the applicable URA.

"Increased Oversight Threshold" means the occurrence of any of the following:[15]

a. during the Construction Period:

i. the cumulative number of Noncompliance Points accrued during:

A. any rolling [12] month period equals or exceeds [ ]; or

B. any rolling [36] month period equals or exceeds [ ]; or

ii. the cumulative number of Noncompliance Events which have a Grace Period which have been cured during the applicable Grace Period in

[15] Thresholds, including time periods, to be provided in a subsequent Addendum.

respect thereof during:

A. any rolling [12] month period equals or exceeds [ ]; or

B. any rolling [36] month period equals or exceeds [ ]; or

b. during the Operating Period:

i. the cumulative number of Noncompliance Points accrued during:

A. any rolling [12] month period equals or exceeds [ ]; or

B. any rolling [36] month period equals or exceeds [ ]; or

ii. the cumulative number of Noncompliance Events which have a Grace Period which have been cured during the Grace Period in respect thereof during:

A. any rolling [12] month period equals or exceeds [ ]; or

B. any rolling [36] month period equals or exceeds [ ].

"Indemnified Party" has the meaning given to it in Section 24.2.

"Independent Assurance" means the reviews and tests described in Schedule 8 (*Project Administration*).

"Independent Quality Control" means all those planned and systematic actions necessary for Developer to certify to the Department that all Work fully complies with the requirements of this Agreement and that all materials incorporated in the Work, all equipment used, and all elements of the Work will perform satisfactorily for the purpose(s) intended.

"Information" has the meaning given to it in Section 2.2.3.c.

"Initial Handback Inspection Report" means the report prepared by Developer in accordance with Section 3.8 of Schedule 12 (*Handback Requirements*).

"Initial Warning Notice" has the meaning given to it in Section 22.2.1.

"Insolvency Event" means, in respect of any Person,

a. any of:

i. the commencement of a voluntary case under Federal bankruptcy law;

ii. the filing of a petition seeking to take advantage of any other law, domestic or foreign, relating to bankruptcy, insolvency, reorganization, winding up or composition for adjustment of debts;

iii. the application for or the consent to the appointment of, or the taking of possession by, a receiver, custodian, trustee, or liquidator of itself or of a substantial part of its property, domestic or foreign;

iv. the admission in writing of its inability to pay its debts as they become due;

v. the making of a general assignment for the benefit of creditors; or

vi. the taking of any corporate (or equivalent) action for the purpose of authorizing any of the foregoing; or

b. the commencement of a case or other proceeding against such Person in any court of competent jurisdiction seeking:

i. relief under Federal bankruptcy law or under any other law, domestic or foreign, relating to bankruptcy, insolvency, reorganization, winding up or adjustment of debts; or

ii. the appointment of a trustee, receiver, custodian, liquidator or the like for such Person or for all or any substantial part of their respective assets, domestic or foreign,

and:

A. the petition that commenced such case or proceeding is not contested by such Person within 10 Calendar Days after commencement of the case or proceeding; or

B. either: (I) such case or proceeding continues without dismissal or stay for a period of 60 Calendar Days; or (II) an order granting the relief requested in such case or proceeding (including, but not limited to, an order for relief under such Federal bankruptcy law) is entered.

"Insolvent" means the condition of a Person in respect of whom an Insolvency Event has occurred.

"Inspection"	means the organized examination or formal evaluation of Work, including manufacturing, design, and maintenance practices, processes, and products, document control and shop drawing review, to ensure that the practices, processes, and products comply with the quality requirements contained in this Agreement.
"Inspecting Parties"	has the meaning given to it in Section 19.1.3.a and "Inspecting Party" means any one of them.
"Insurance Policies"	means all the insurance policies that Developer is required to effect and maintain, or procure, pursuant to Section 24 and Schedule 13 (*Required Insurances*).
"Intelligent Transportation Systems" or "ITS"	means the information and communication technologies used to inform roadway users, collect data and collect tolls.
"Interior Zone"	means the length of roadway between the Transition Zone and the Exit Zone and which has constant illumination.
"Internal Revenue Code"	means the Internal Revenue Code of 1986, and the Regulations promulgated by the U.S. Department of Treasury.
"ITP"	has the meaning given to it in the Recitals.
"Key Milestone"	means each of the dates for issuance of NTP1, NTP2 and NTP3, the Milestone Completion dates, the Baseline Substantial Completion Date, the Final Acceptance Date and the dates for key Deliverables required to be submitted pursuant to any provision of this Agreement, including the Technical Requirements.
"Key Personnel"	means the individuals identified in Schedule 27 (*Key Personnel*) to fill the various job positions set out in that Schedule, and any replacement personnel Accepted pursuant to Section 16.1.
"Key Ratios"	means [ ].[16]
"Known or Knowable"	means any risk, information, matter or thing that on or prior to the Setting Date was: a. identified, described or contemplated in the Project Information, the I-70 East EIS or any Department Provided Approval; b. otherwise disclosed to or known, identified, discovered or observed by the Preferred Proposer or a Developer-Related Entity; or c. Reasonably Identifiable.
"Laboratory"	means the testing laboratory of Developer, CDOT or any other certified testing laboratory.
"Law"	means:

[16] To be completed based on relevant ratios in the Financing Documents.

a. any statute, law (including common law), code, regulation, ordinance or rule;

b. any binding judgment, judicial or administrative order or decree (other than one rendered pursuant to the Dispute Resolution Procedures);

c. any written directive, guideline, policy requirement, methodology or other governmental restriction or requirement (including those resulting from an initiative or referendum process, but excluding those by the Enterprises within the scope of their administration of this Agreement); and

d. any similar form of decision of or determination by, or any written interpretation or administration of any of the foregoing by, any Governmental Authority,

in each case that is applicable to or has an impact on the Project or the Work (where such applicability or impact shall be determined by reference to the context in which the term Law is used)), whether taking effect before or after the Agreement Date, including Environmental Laws, but excluding Governmental Approvals.

"Lender" means any Person that provides Project Debt, together with their respective successors, assigns, participating parties, trustees and agents, including the Collateral Agent.

"Lender Direct Agreement" means the agreement in substantially the form attached in Schedule 19 (*Forms of Direct Agreement*) by and among the Enterprises, Developer, and the Lender (or if there is more than one Lender, the Collateral Agent on behalf of the Lenders).

"Level of Service" means, in relation to O&M Work, the level of service as described in CDOT's Maintenance Level of Service Manual.

"Local Agency" means any local Governmental Authority other than the State or an agency thereof.

"Local Agency Roadway" means roadways excluding CDOT Roadways and the I-70 Mainline.

"Long Term Project Debt" means the aggregate amount of Project Debt that by its terms or pursuant to the Financial Model:

a. is scheduled to remain outstanding after the Substantial Completion Date; and

b. not scheduled to be repaid with a Milestone Payment or the Substantial Completion Payment.

"Longstop Date" means the date that is 18 months after the Baseline Substantial Completion Date as such Longstop Date may be extended from time to time as a result of:

a. pursuant to Section 15.3.1.e.iv, a Supervening Event; or

b. a Change.

"Loss" or "Losses"	means any loss, damage, cost, expense, charge, fee, injury, liability, obligation, judgment, penalty or fine, in each case including attorneys', accountants' and expert witnesses' fees and expenses (including those incurred in connection with the enforcement of any indemnity or other provision of this Agreement).
"Lowered Section"	means the segment of the I-70 Mainline with the proposed vertical profile is modified, between Brighton Boulevard and Dahlia Street.
"Maintenance Employee"	means any person employed by Developer or any Subcontractor in connection with the performance of the O&M Work who works directly on the maintenance of highways or roadways, excluding any person who is employed by a Subcontractor and who regularly works on the maintenance of highways or roadways other than those that are included in the Project.
"Maintenance Management Information System"	means the system required to be established and maintained by Developer in accordance with of Section 7 of Schedule 11 (*Operations and Maintenance Requirements*).
"Maintenance Management Plan (MMP)"	means the plan referred to in Section 5 of Schedule 11 (*Operations and Maintenance Requirements*) that sets out how Developer will comply with its maintenance obligations under this Agreement (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).
"Maintenance Yard"	has the meaning given to it in Section 2.2.5 of Schedule 11 (*Operations and Maintenance Requirements*).
"Managed Lanes"	has the same meaning as Tolled Express Lanes.
"Measurement Criteria"	means, in respect of an Element, the measurement criteria applicable to such Element specified in the "Measurement Criteria" column in the Performance and Measurement Tables (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).
"Microwave Vehicle Radar Detection"	means a side fire radar used to collect point data of volume, occupancy, speed and classification on each lane of travel.
"Mile High Courtesy Patrol"	is the courtesy patrol program operated by CDOT.
"Milestone 1"	means the Construction Work between Sand Creek Bridge and Chambers Road (Station 2192+00 to 2448+00) comprising the addition of one Tolled Express Lane in each direction within the limits.
"Milestone 2"	means the Construction Work between Dahlia Street and Sand Creek Bridge (Station 2105+00 to 2192+00) comprising the addition of one Tolled Express Lane in each direction within the limits.

"Milestone 3"	means the Construction Work between Brighton Blvd and Dahlia Street (Station 2000+00 to 2105+00) comprising westbound I-70 and 46th Avenue/Stapleton Drive (north of I-70), and the UPRR Crossing.
"Milestone 4"	means the Construction Work between Brighton Blvd and Dahlia Street (Station 2000+00 to 2105+00) comprising eastbound I-70 and 46th Avenue/Stapleton Drive (south of I-70).
"Milestone Completion"	[*To be provided in a subsequent Addendum.*]
"Milestone Completion Certificate"	[*To be provided in a subsequent Addendum.*]
"Milestone Completion Conditions"	[*To be provided in a subsequent Addendum.*]
"Milestone Completion Date"	[*To be provided in a subsequent Addendum.*]
"Milestone Completion Punch List"	[*To be provided in a subsequent Addendum.*]
"Milestone Payment"	has the meaning given to it in Section 1 of Schedule 5 (*Milestone Payments*).
"Milestone Payment Request Due Date"	has the meaning given to it in Section 2 of Schedule 5 (*Milestone Payments*).
"Milestone Payment Request"	has the meaning given to it in Section 2 of Schedule 5 (*Milestone Payments*).
"month"	means a month as determined by reference to the time and date in Denver, Colorado.
"Monthly Construction Closure Deduction"	means, for any month, an amount equal to the sum of the Construction Closure Deductions that accrued during such month, calculated in accordance with Section 3 of Part 1 of Schedule 6 (*Performance Mechanism*).
"Monthly Deductions Report"	means a report submitted by Developer to the Enterprises pursuant to Section 2.1 of Part 1 of Schedule 4 (*Payments*), Section 3.1 of Part 2 of Schedule 4 (*Payments*) or Section 4(b)(ii) of Schedule 5 (*Milestone Payments*).
"Monthly Noncompliance Deduction"	means, for any month, an amount equal to the sum of the deductions that accrued during such month in respect of Noncompliance Events, calculated in accordance with, as applicable, Section 2 of Part 1 of Schedule 6 (*Performance Mechanism*) or Section 2 of Part 3 of Schedule 6 (*Performance Mechanism*).
"Monthly O&M Report"	has the meaning given to it in Section 13.1 of Schedule 11 (*Operations and Maintenance Requirements*).
"Monthly Operating Period Closure	means, for any month, an amount equal to the sum of the Operating Period Closure Deductions that accrued during such month, calculated in

Deduction"	accordance with Section 3 of Part 3 of Schedule 6 (*Performance Mechanism*).
"Monthly Performance Deduction"	means, for any month, an amount equal to the aggregate of the Monthly Noncompliance Deduction and the Monthly Operating Period Closure Deduction, in each case, for such month.
"Monthly Progress Schedule"	means the monthly updated program schedule submitted pursuant to Section 3.3.5 of Schedule 8 (*Project Administration*).
"MOT Task Force"	means a team established by Developer pursuant to Section 2.2.6 of Schedule 10 (*Design and Construction Requirements*) to assume proper coordination with Governmental Authorities affected by the Work, in relation to maintenance of traffic.
"MOT Variance"	means a variance to the requirements applicable to Closures, detours and any other restrictions set out in Section 2 (*Maintenance of Traffic*) of Schedule 10, as Approved by the Department or approved by the relevant Local Agency, as applicable, in accordance with Section 2.3 of Schedule 10 (*Design and Construction Requirements)*.
"NEPA"	has the meaning given to it in the Recitals.
"New Environmental Approvals"	means any of the following: a. a new Environmental Approval; and b. a modification, renewal or extension of an existing Environmental Approval.
"No Better and No Worse"	shall be interpreted pursuant to Section 28.2.
"No Conflict Form"	means a form set out in Appendix A to Section 4 of Schedule 10.
"Noncompliance and Closure Database"	means the database described in Section 2 of Part 6 of Schedule 6 (*Performance Mechanism*).
"Noncompliance Cure Period"	means: a. for any Noncompliance Event for which the Cure Period is specified in days, each continuous period of "x" days commencing from and including: i. if such Noncompliance Event does not have a Grace Period, the Noncompliance Start Time of such Noncompliance Event; or ii. if such Noncompliance Event has a Grace Period, the expiry of such Grace Period, in each case, to and excluding the Noncompliance Rectification Time of such Noncompliance Event, where "x" equals the number of days specified as the Cure Period for such Noncompliance Event; and

b. for any Noncompliance Event for which the Cure Period is specified in hours or months, each continuous period of "x" hours or months, respectively, commencing from and including the Noncompliance Start Time of such Noncompliance Event to and excluding the Noncompliance Rectification Time of such Noncompliance Event, where "x" equals the number of hours or months, as applicable, specified as the Cure Period for such Noncompliance Event.

"Noncompliance Default Event" means the occurrence of any of the following:[17]

a. during the Construction Period:

i. the cumulative number of Noncompliance Points accrued during:

A. any rolling [12] month period equals or exceeds [ ]; or

B. any rolling [36] month period equals or exceeds [ ]; or

ii. the cumulative number of Noncompliance Events which have a Grace Period which have been cured during the applicable Grace Period during:

A. any rolling [12] month period equals or exceeds [ ]; or

B. any rolling [36] month period equals or exceeds [ ]; or

a. during the Operating Period:

i. the cumulative number of Noncompliance Points accrued during:

A. any rolling [12] month period equals or exceeds [ ]; or

B. any rolling [36] month period equals or exceeds [ ]; or

ii. the cumulative number of Noncompliance Events which have a Grace Period which have been cured during the applicable Grace Period during:

A. any rolling [12] month period equals or exceeds [ ]; or

B. any rolling [36] month period equals or exceeds [ ].]

[17] Thresholds, including time periods, to be provided in a subsequent Addendum.

"Noncompliance Event" means any failure:

a. set out in Table 6A.1 which occurs during the Construction Period; and

b. set out in Table 6A.2 which occurs during the Operating Period.

"Noncompliance Points" means the points accrued by Developer in respect of the occurrence of Noncompliance Events in accordance with Part 4 of Schedule 6 (*Performance Mechanism*).

"Noncompliance Rectification Time" means, in respect of any Noncompliance Event which has a Cure Period, the date and time that the Noncompliance Event is fully cured.

"Noncompliance Start Time" means:

a. for any Noncompliance Event, whether or not such Noncompliance Event has a Cure Period (other than a Noncompliance Event for which the Cure Period is specified as the "Defect Remedy Period"), the date and time that the Noncompliance Event occurs; and

b. for any Noncompliance Event for which the Cure Period is specified as the "Defect Remedy Period", the date and time that the applicable Defect Remedy Period expires.

"Nonconforming Work" means Work performed by Developer that does not meet the requirements of this Agreement.

"Non-Permitted Closure" means:

a. during the Construction Period, any Non-Permitted Construction Closure; or

b. during the Operating Period, any Non-Permitted Operating Period Closure.

"Non-Permitted Construction Closure" means any Closure that:

a. results in a breach of, or is not permitted by, any of Sections 2.5.3, 2.6, 2.7, 2.9, 2.11.5, 2.11.8, 2.11.9, 2.11.10 or 2.11.11 of Schedule 10 (*Design and Construction Requirements*), unless such Closure has been Approved by the Department or approved by the relevant Local Agency, as applicable, as a MOT Variance; and

b. is not an Excused Closure.

"Non-Permitted Operating Period Closure" means a Closure that occurs during the Operating Period in an O&M Segment that:

a. is not a Permitted Operating Period Closure; and

b. is not an Excused Closure.

"notice" (or "Notice")	has the meaning given to it in Section 49.1.1, and the terms "notify" and "notified" shall refer to the act of delivering such a notice.
"Notice of Possession"	means a notice delivered by the Enterprises to Developer specifying the Calendar Day (the "Possession Date") on which the Enterprises shall deliver to Developer Possession of one or more ROW Parcels or Additional ROW Parcels identified in such notice.
"Notifiable Refinancing"	means any Refinancing that is not a Qualifying Refinancing.
"NTP1"	[*To be provided in a subsequent Addendum.*]
"NTP1 Conditions"	[*To be provided in a subsequent Addendum.*]
"NTP1 Work"[18]	[*To be provided in a subsequent Addendum.*]
"NTP2"	[*To be provided in a subsequent Addendum.*]
"NTP2 Conditions"	[*To be provided in a subsequent Addendum.*]
"NTP3"	[*To be provided in a subsequent Addendum.*]
"NTP3 Conditions"	[*To be provided in a subsequent Addendum.*]
"Offsite Outfall System"	means the drainage system to be constructed pursuant to Section 8.4.9.a of Schedule 10 (*Design and Construction Requirements*) conveying flows generated from outside the Site and capturing the flow preventing it from draining into the Lowered Section, that will be located to the south of I-70 Mainline and consists of ponds and large Storm Drains, routed through Globeville Park and discharge into the South Platte River.
"Onsite Outfall System"	means the drainage system to be constructed pursuant to Section 8.4.9.b of Schedule 10 (*Design and Construction Requirements*) conveying flows generated from the onsite roadway area located within the Lowered Section to the north, with a discharge into the South Platte River.
"O&M Contract"	means the contract for the performance of the O&M Work [including / excluding][19] O&M Work During Construction entered into between Developer and the O&M Contractor in compliance with Section 17, provided that, if and to the extent of any self-performance of O&M Work by Developer, references to such term shall be construed either as references to this Agreement, or as inapplicable, as the context may require.[20]
"O&M Contractor"	means the Subcontractor engaged by Developer under the O&M Contract, provided that, if and to the extent of any self-performance of O&M Work by Developer, references to such term shall be construed either as

[18] It is anticipated that NTP1 Work will include design work, limited Site investigations that are authorized by right of entry permits, and the work required to develop the required Deliverables to achieve NTP2.
[19] To be amended to reflect contractual structure of Preferred Proposer.
[20] This defined term assumes that there will be a single such contract. This definition, and related provisions (including the definition of O&M Contractor), will be adjusted at the Enterprises' reasonable discretion to reflect any Proposal that proposes a different (but otherwise permissible or Enterprise approved) contracting arrangement.

references to Developer, or as inapplicable, as the context may require.

"O&M Limits" means:

a. prior to (and including) the Substantial Completion Date, the O&M Limits during Construction; and

b. after the Substantial Completion Date, the O&M Limits After Construction.

"O&M Limits After Construction" means the limits specified in the drawings referred to in Section 3.1 of Schedule 11 (*Operations and Maintenance Requirements*), as Accepted by the Department (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).

"O&M Limits During Construction" means the limits specified in the drawings referred to in Section 2.1 of Schedule 11 (*Operations and Maintenance Requirements*), as Accepted by the Department (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).

"O&M Limits Reference Drawings" means the drawings provided as Reference Documents and listed in document number 29.11.01 of Schedule 29 (*Reference Documents*).

"O&M Period During Construction" means the period commencing on the date of issuance of NTP2 and ending on (and including) the Substantial Completion Date (or, if earlier, the Termination Date).

"O&M Quality Management Plan" means the plan described in Section 5.4 of Schedule 11 (*Operations and Maintenance Requirements*) (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).

"O&M Safety Plan" means the plan described in Section 5.3 of Schedule 11 (*Operations and Maintenance Requirements*), (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).

"O&M Segment" means any one of the following segments of the Project along I-70 Mainline:

O&M Segment	Start	End
1	274.000 (I-25 Interchange)	276.572 (Colorado Blvd)
2	276.572 (Colorado Blvd.)	278.548 (Quebec St.)
3	278.548 (Quebec St.)	282.563 (I-225)
4	282.563 (I-225)	285.727 (Tower Road)

"O&M Standards" means:

a. any standards and specifications expressly referenced in this Agreement (including in Section 1.1.5 of Schedule 11 (*Operations and Maintenance Requirements*)) as

applicable to the O&M Work (excluding, for certainty, any Laws, Governmental Approvals or Permits); and

b. any standards and specifications that apply to the O&M Work (excluding, for certainty, any Laws, Governmental Approvals or Permits), including as a result of Developer's methods of performing the O&M Work,

in each case in the form published or otherwise in effect as of the Setting Date (subject to change, addition or replacement pursuant to Section 8.6).

"O&M Work" means any and all operations, management, administration, maintenance, repair, preservation, modification, reconstruction, rehabilitation, restoration, renewal and replacement work and activities, including Routine Maintenance, Renewal Work and Work undertaken pursuant to the Handback Requirements, in each case required to be carried out by Developer to comply with all requirements set out in Schedule 11 (*Operations and Maintenance Requirements*) and any other provisions of this Agreement applicable to the performance of O&M Work during the Construction Period or the Operating Period, as applicable.

"O&M Work After Construction" means any and all O&M Work required to be carried out by Developer during the Operating Period pursuant to Section 3 and other provisions of Schedule 11 (*Operations and Maintenance Requirements*).

"O&M Work During Construction" means any and all O&M Work required to be carried out by Developer during the O&M Work During Construction Period pursuant to Section 2 and other provisions of Schedule 11 (*Operations and Maintenance Requirements*).

"OP Deduction Month" has the meaning given to it in Section 3.2 of Part 2 of Schedule 4 (*Payments*).

"Operating Period" means the period that begins on the Calendar Day after the Substantial Completion Date and ends on the earlier of the Expiry Date and the Termination Date.

"Operating Period Closure Deduction" means, in respect of each full or partial Closure Deduction Period that commences in respect of any Non-Permitted Operating Period Closure:

a. if such Closure Deduction Period commences on a Calendar Day that is not during a Weekend and is not a Holiday, the amount set out in the Operating Period Closure Deductions Table for the type of Closure that caused such Non-Permitted Operating Period Closure;

b. if such Closure Deduction Period commences on a Calendar Day that is during a Weekend, 50% of the amount set out in the Operating Period Closure Deductions Table for the type of Closure that caused such Non-Permitted Operating Period Closure; or

c. if such Closure Deduction Period commences on a Calendar Day that is a Holiday, 150% of the amount set out in the Operating Period Closure Deductions Table for

the type of Closure that caused such Non-Permitted Operating Period Closure,

subject, in the case of a., b. and c., to the provisions of Section 2 of Part 5 of Schedule 6 (*Performance Mechanism*).

"Operating Period Closure Deductions Table" means the table set out in Section 3.2 of Part 3 of Schedule 6 (*Performance Mechanism*) (subject to amendment pursuant to Section 3.3 of Part 3 of Schedule 6 (*Performance Mechanism*)).

"Operations Management Plan (OMP)" means the plan referred to in Section 9 of Schedule 11 (*Operations and Maintenance Requirements*) that sets out how Developer will comply with its operations obligations under this Agreement (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).

"Organizational Conflict of Interest" means an organizational conflict of interest as described in 2 C.C.R. 601-15 Sec. 7 or as defined under 23 CFR § 636.116, where for purposes of 23 CFR § 636.116:

a. the "person" referred to in that definition was a Core Proposer Team Member or a contractor, subcontractor, advisor, consultant or subconsultant to the Preferred Proposer or any Core Proposer Team Member; and

b. the "owner" referred to in that definition is each Enterprise and CDOT.

"Other Department Project" means any Related Transportation Facility that is:

a. constructed and operated and/or maintained by or on behalf of the Enterprises and/or CDOT (other than by Developer to the extent such project is not a Developer Retained Expansion) during the Term; and

b. not otherwise incorporated in the Project under the terms of this Agreement.

"Other Department Project Procurement Material" means any design brief, specification, information memorandum, request for qualification, request for proposal, contract or other documentation issued or otherwise made available by the Enterprises and/or CDOT in connection with the tender or procurement of any Other Department Project.

"PABs" means bonds, notes or other evidence of indebtedness issued by the PABs Issuer in the form of "private activity bonds" that are also "exempt facility bonds" under the Internal Revenue Code, where such issuance is made pursuant to the provisions of Internal Revenue Code Sections 142(a)(15) and (m).

"PABs Issuer" means BE acting solely in the capacity of a conduit issuer of PABs under the authority of Law.

"Parties" means, collectively, the Enterprises and Developer, and "Party" means either the Enterprises (taken together) or Developer.

"Payment Milestone" means any of Milestone 1, Milestone 2, Milestone 3 or Milestone 4.

"Payment Month" means:

a. each month that commences during the Operating Period; and

b. the month during which the Substantial Completion Date occurs.

"Payment Request" means a payment request submitted by Developer to the Enterprises pursuant to Section 2.1 or 2.2 of Part 2 of Schedule 4 (*Payments*).

"Performance and Measurement Tables" means the performance and measurement tables set out in Appendix A-1 and Appendix A-2 to Schedule 11 (*Operations and Maintenance Requirements*) for, respectively, the O&M Work During Construction Period and the Operating Period (as the same may be updated from time to time in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).

"Performance Payment" means any monthly payment payable by the Enterprises pursuant to Section 1 of Part 2 of Schedule 6 (*Performance Mechanism*).

"Performance Requirements" means the requirements set out in the column headed "Performance Requirements" in the Performance and Measurement Tables.

"Permission to Enter Property Form" means CDOT Form 730 "Permission to Enter Property".

"Permit Area" means, any area adjacent to any ROW Parcel or any Additional ROW Parcel for which access and/or use is required to be procured by Developer pursuant to a Permit in order to perform the Work.

"Permits" means any permit, license, temporary crossing agreement or right-of-entry agreement issued, granted or entered into by or with any Governmental Authority, Utility Owner or Railroad in connection with the performance of any of Developer's obligations under this Agreement.

"Permitted Encumbrances" means:

a. any Encumbrance expressly permitted by Section 27.3;

b. any Encumbrance for taxes, assessments or governmental charges or levies not yet due and payable, or any Encumbrance for taxes, assessments or governmental charges or levies being contested in good faith and by appropriate proceedings for which adequate reserves have been established in accordance with GAAP; and

c. sublicenses expressly permitted under Section 7.2.2.

"Permitted Equity Transfer" means an Equity Transfer arising as a direct result of:

a. a bona fide open market transaction in securities effected

on a recognized public stock exchange, excluding such transactions involving an initial public offering;

b. a bona fide crowdfunding transaction in securities issued pursuant to an exemption from registration in compliance with the JOBS Act of 2012 or any equivalent or successor Law provided that:

i. no Change of Control occurs as a result of such transaction; and

ii. the Enterprises have provided their prior consent to such transaction, such consent not to be unreasonably withheld;

c. the grant or enforcement of security over the [ ][21] in Developer pursuant to the Financing Documents in favor of the Lenders as permitted by Section 27.3;

d. a transfer of interests between:

i. managed funds that are under common ownership or control; or

ii. the general partner or the manager (or the parent company of such general partner or manager) and any managed funds under common ownership or control with such general partner or manager (or parent company of such general partner or manager),

provided that the relevant funds and the general partner or manager of such funds (or the parent company of such general partner or manager) have been approved by the Enterprises in writing prior to the Agreement Date;[22]

e. a reorganization or transfer within a group of Persons under common Control of direct or indirect ownership interests in any Person or of any intermediate entity in the chain of ownership of such Person so long as there is no change in the entity or entities that ultimately have Control of such Person; or

f. a donation of legal, beneficial or equitable ownership interests in a Person to an independent non-profit organization registered with the State and exempt from taxation under section 501(c)(3) of the Internal Revenue Code provided that:

i. no Change of Control occurs as a result of such transaction; and

[21] To refer to shares, membership interests etc. as applicable.
[22] The Enterprises are willing to permit transfers of equity interests between affiliated funds or corporate entities during the Restricted Transfer Period that are identified to (and approved by) the Enterprises prior to the Agreement Date pursuant to the ITP.

ii. the Enterprises have provided their prior consent to such transaction, such consent not to be unreasonably withheld.

"Permitted Operating Period Closure" means any Closure required for the purposes of Developer performing Routine Maintenance or Renewal Work in compliance with the most recently Accepted Maintenance Management Plan (including, for certainty, in the case of Renewal Work, the most recently Accepted Renewal Work Plan) that:

a. does not result in a breach of any of, and is permitted by, Sections 2.5.3, 2.6, 2.7, 2.9, 2.11.5, 2.11.8, 2.11.9, 2.11.10 or 2.11.11 of Schedule 10 (*Design and Construction Requirements*), as if the provisions of such Sections applied to the performance of Routine Maintenance or Renewal Work, as applicable, during the Operating Period; or

b. if such Closure does not satisfy the requirement set out in paragraph a. of this definition, has been Approved by the Department or approved by the relevant Local Agency, as applicable, as a MOT Variance.

"Persistent Breach" has the meaning given to it in Section 22.2.2.e.

"Person" means any of a natural person, a corporation, a limited liability company, a trust, a partnership, a limited liability partnership, a joint stock company, a consortium, a joint venture, an unincorporated association or any other entity recognized as having legal personality under the laws of the State, in each case as the context may require.

"Point of Slope Selection" means the location at which the roadside slope adjacent to the pavement ends, and the cut, or fill slope begins.

"Portal" means the face of the Cover where the Threshold Zone begins.

"Possession" means, in relation to any ROW Parcel or any Additional ROW Parcel the right to access and use such ROW Parcel or of any Additional ROW Parcel in accordance with the terms of this Agreement, subject to:

a. rights, including statutory or public franchise rights, of Governmental Authorities, Utility Owners, Railroads and third parties to have access to:

i. such ROW Parcel existing as of the Setting Date; and

ii. such Additional ROW Parcel existing as of the Project License Start Date with respect to such Parcel,

including in either case as such access may be permitted and regulated by CDOT including through the issuance of Access Permits;

b. rights, including rights of access, granted to the Enterprises and CDOT and each of their employees, agents, consultants and subcontractors and to other Persons under this Agreement;

c. access rights of the Project Third Parties as contemplated by the Third Party Agreements;

d. restrictions of use set out in easement deeds and/or right of entry permits applicable to any ROW Parcel or any Additional ROW Parcel, as such restrictions are:

i. specified in any public record or the Reference Documents; and

ii. with respect to any Additional ROW Parcel, in existence on the applicable Project License Start Date;

e. restrictions set out in any title commitments or American Land Title Association maps related to the Right-of-Way as set out in the Reference Documents;

f. other easements, zoning restrictions, regulations, rights of way and similar restrictions on real property imposed by Law; or

g. any other restrictions or qualifications set out in Schedule 18 (*Right-of-Way*).

"Possession Date" has the meaning given to it in the definition of Notice of Possession in this Part A of Annex A (*Definitions and Abbreviations*).

"Precipitation Event" means any type of event or occurrence causing slippery road conditions including snow, drifting snow, freezing rain, sleet, ice and frost.

"Preferred Alternative" means the alternative chosen as the "Preferred Alternative" pursuant to NEPA in the FEIS related to the Project.

"Preferred Proposer" means the Proposer that formed Developer for purposes of entering into this Agreement.

"Preliminary Equity IRR" means [ ]%.[23]

"Pre-Refinancing Equity IRR" means, in relation to the Refinancing, the nominal post-tax Equity IRR calculated by reference to the rate identified in the Base Financial Model on the date immediately preceding the date on which such Refinancing is put into place.

"Principal Indemnified Parties" has the meaning given to it in Section 24.2.

"Principal Subcontractor means the agreement in substantially the form attached as Schedule 19 (*Forms of Direct Agreement*) by and among the Enterprises, Developer,

[23] Insert the Equity IRR included in the Preferred Proposer's Preliminary Financial Model.

Direct Agreement" and a Principal Subcontractor.

"Principal Subcontractors" means:

a. the Construction Contractor;

b. the O&M Contractor; and

c. any other Subcontractor that enters into a Principal Subcontract with Developer.

"Principal Subcontracts" means:

a. the Construction Contract;

b. the O&M Contract; and

c. any other Subcontract between Developer and another Principal Subcontractor that is designated by the Enterprises (acting reasonably) as a Principal Subcontract.

"Private Utility" means a Utility that is owned by a Private Utility Owner.

"Private Utility Owner" means each of:

a. AT&T Corp.;

b. Comcast Holdings Corporation;

c. Level 3 Communications, Inc.;

d. MCI Communications Services, Inc. d/b/a Verizon Business Services;

e. Neustar Inc.;

f. Phillips 66 Company;

g. Public Service Company of Colorado;

h. Qwest Corporation d/b/a CenturyLink QC;

i. Sprint Communications Company, L.P.; and

j. Zayo Group, LLC,

or any Affiliate of the same with which the CDOT enters into a URA.

"Process Control" means the activities performed by or on behalf of Developer to ensure and document that a product meets the requirements of this Agreement, which activities may include checking, materials handling and construction procedures, calibrations and maintenance of equipment, shop drawing review, document control, production process control, and any sampling,

testing, and inspection done for such purposes.

"Progress Report" means Developer's progress submittal described in Section 4 of Schedule 8 (*Project Administration*).

"Progress Schedule" means the Contract Schedule provided with the Progress Report as set out in Section 3.3 of Schedule 8 (*Design and Construction Requirements*).

"Prohibited Act" means:

a. an act committed in contravention of Section 8.3.2;

b. offering, giving or agreeing to give to any public official or any civil servant or to any employee or other Person providing goods or services to either Enterprise or CDOT on a contractual basis or any other division or agency of the State, including CDOT, or of the Federal government any gift or consideration of any kind as an inducement or reward:

i. for doing or not doing (or for having done or not having done) any act in relation to the obtaining or performance of this Agreement or any other related contract with either Enterprise or the Federal government or the State, or any division, subdivision or agency of either of them (including CDOT); or

ii. for showing or not showing favor or disfavor to any Person in relation to this Agreement or any other related contract with either Enterprise or the Federal government or the State, or any division, subdivision or agency of either of them (including CDOT);

c. the existence of an Organizational Conflict of Interest which was known, or should have been known, and which was not disclosed to the Enterprises pursuant to the ITP before the Agreement Date;

d. entering into this Agreement or any other related contract with either Enterprise or the Federal government or the State, or any division, subdivision or agency of either of them (including CDOT) in connection with which commission has been paid or has been agreed to be paid by or on behalf of Developer or any Core Proposer Team Member of the Preferred Proposer, or to the knowledge of any of them, unless before the relevant contract is entered into particulars of any such commission and of the terms and conditions of any such contract for the payment thereof have been disclosed in writing to the Enterprises and the Enterprises, in their discretion, have waived any objection to the same; or

e. defrauding or attempting to defraud or conspiring to

defraud either Enterprise or the Federal government or the State, or any division, subdivision or agency of either of them (including CDOT),

in each case regardless of whether or not it is a criminal offence pursuant to Law.

"Project" has the meaning given to it in the Recitals.

"Project Debt" means bona fide indebtedness (including subordinated indebtedness) under the Financing Agreements for or in respect of funds borrowed or incurred (including bona fide indebtedness with respect to any financial insurance issued for funds borrowed) or for the value of goods or services rendered or received, the repayment of which has specified payment dates and, in any such case, is secured by one or more Security Documents, where such Project Debt:

a. includes, subject to the exclusions in paragraph b. of this definition:

i. principal, capitalized interest, accrued interest, customary and reasonable lender, financial insurer, agent and trustee fees, costs, expenses and premiums with respect thereto, payment obligations under interest rate and inflation rate hedging agreements or other derivative facilities with respect thereto, reimbursement obligations with respect thereto, lease financing obligations, and Breakage Costs; and

ii. PABs and TIFIA Loans (and TIFIA guaranties and credit support), together with the obligations arising thereunder; and

b. excludes:

i. Equity Member Debt;

ii. any indebtedness of Developer or any Equity Member of Developer that is secured by any interests less than Developer's entire interest in, and its rights and obligations under, this Agreement, such as indebtedness secured only by an assignment of economic interest in Developer or of rights to cash flow or dividends from Developer;

iii. any increase in indebtedness to the extent resulting from an agreement or other arrangement Developer enters into or first becomes obligated to repay after it was aware (or should have been aware, with reasonable due diligence) of the occurrence or prospective occurrence of an event of termination under the Agreement, including Developer's receipt of a

Termination Notice and/or occurrence of an Enterprise Default of the type entitling Developer to terminate the Agreement; and

iv. any such indebtedness that would otherwise be Project Debt to the extent the Collateral Agent has not notified the Enterprises of such indebtedness and the related Financing Documents in accordance with this Agreement.

"Project Directory" means the directory described in Section 12 of Schedule 8 (*Project Administration*).

"Project Information" has the meaning given to it in Section 3.1.1.a.

"Project License" has the meaning given to it in Section 7.2.1.a.

"Project License End Date" means, for each ROW Parcel and each Additional ROW Parcel, the earliest of:

a. the date on which the Project License is revoked pursuant to Section 7.2.1.c;

b. the Substantial Completion Date with respect to any ROW Parcels and any Additional ROW Parcels (or any portion of any thereof) that are outside the O&M Limits After Construction; and

c. with respect to any such ROW Parcel and any Additional ROW Parcel that is provided in the form of a Temporary Easement, the date specified in or required by the terms of such easement.

"Project License Start Date" means, for each ROW Parcel and each Additional ROW Parcel, the Possession Date specified in the Notice of Possession delivered by the Enterprises to Developer pursuant to Section 7.2.1.b with respect to such parcel.

"Project Records" has the meaning given to it in Section 19.1.1.

"Project Schedule" means, initially, the Baseline Schedule and, once Approved pursuant to Section 3.3 of Schedule 8 (*Project Administration*), the then current Revised Baseline Schedule.

"Project Standards" means:

a. the Construction Standards; and

b. the O&M Standards.

"Project Third Parties" means each counterparty (excluding any Party to this Agreement and CDOT) to a Third Party Agreement.

"Property Management" has the meaning given to it in Section 2.1.1 of Schedule 18 (*Right-of-*

Way).

"Proposal"	means the Preferred Proposer's Proposal, as defined in and submitted by it in response to, the ITP.
"Proposal Extracts"	means Schedule 28 (*Proposal Extracts*). [24]
"Proposal Schedule"	means the draft Baseline Schedule submitted by the Preferred Proposer with Developer's Proposal pursuant to Section 2.3.3. of Part F of the ITP.
"Proposer"	has the meaning given to it in the Recitals.
"Protection in Place"	has the meaning given to it in the applicable URA.
"Public Utility"	means a Utility that is owned by a Publicly Owned Utility.
"Publicly Owned Utility"	means each of: a. Aurora Water; b. the City and County of Denver, acting through its Board of Water Commissioners; c. the City and County of Denver Wastewater Management Division; and d. the Metropolitan Wastewater Reclamation District.
"Punch List"	[*To be provided in a subsequent Addendum.*]
"Punch List Item"	[*To be provided in a subsequent Addendum.*]
"Qualifying Refinancing"	means any Refinancing that will give rise to a Refinancing Gain greater than zero which is not an Exempt Refinancing.
"Quality Assurance Oversight"	means the act of testing or inspecting of the Work performed by qualified testing or inspecting personnel employed by the Department or its designated agent to independently establish conformity to this Agreement.
"Quality Management Plan"	means, from time to time, the then current plan that satisfies the requirements of Section 6 of Schedule 8 (*Project Administration*) and has been submitted by Developer and Approved by the Department pursuant to Schedule 8 (*Project Administration*).
"Quality Records Database"	means the secure web-based application for recording results of the Department verification reviews and responses to nonconformance notices, as described in Schedule 8 (*Project Administration*).
"Railroad"	means either the tracks, bridges and systems used for rail traffic in the vicinity of I-70 Mainline, or the UPRR, BNSF or DRIR, as the context may require.

[24] The extent of incorporation of the Preferred Proposer's Proposal (and associated ATCs) submitted in response to the ITP into this Agreement will be detailed in a subsequent Addendum.

"Railroad Forces" means Railroad engineering and construction personnel, or Railroad designated contractors employed or contracted directly by the respective Railroad.

"Rating Agency" means each of:

a. Fitch, Inc.;

b. Moody's Investors Service, Inc.;

c. Standard & Poor's Ratings Services; and

d. DBRS, Inc.,

provided in each case that such entity is at the relevant time a Registered Rating Agency.

"Reasonable Efforts" means all those steps in the power of the relevant Party that are capable of producing the desired result, being steps which a prudent, determined and reasonable person desiring to achieve that result would take, provided that, subject to its other express obligations under this Agreement:

a. where the relevant Party is either the Enterprises or Developer, the relevant Party shall not be required to expend funds in taking such steps except for those necessary to meet the reasonable costs reasonably incidental or ancillary to the steps to be taken by the relevant Party (including its reasonable travel expenses, correspondence costs and general overhead expenses);

b. where the relevant Party is the Enterprises (or the Department), the Enterprises (or, as applicable, the Department) shall not be required to:

i. take any action to the extent uncommitted budgeted funds are unavailable to undertake such action;

ii. take any action that is contrary to this Agreement, Law, any Governmental Approval, public policy or the public interest, or decline, refrain or abstain from taking any action that is in the public interest, as determined by the Enterprises in their discretion;

iii. exercise or refrain, decline or abstain from exercising any statutory or administrative law power, authority or discretion;

iv. undertake any mitigation measure that might be available as a result of its status as a Governmental Authority, and that would not normally be available to a private commercial counterparty to an agreement such as this

Agreement;

v. take a position that would not be usual and customary for the Enterprises to take in addressing similar circumstances affecting other projects (except for usual and customary arrangements that are incompatible with the Project's contracting methodology); or

vi. refrain from concurring with a position taken by any Governmental Authority if the Enterprises believe that position to be correct.

"Reasonably Identifiable" means any information, matter or thing that could reasonably have been known, identified, discovered, observed or anticipated by a Developer-Related Entity or the Preferred Proposer undertaking due diligence prior to the Setting Date pursuant to Good Industry Practice, and taking into account (without limitation):

a. the provisions of the ITP with respect to the conduct of due diligence prior to the Setting Date;

b. the Enterprises' approval of and response to Proposers' diligence-related requests and comments submitted pursuant to the ITP to the extent:

i. submitted by the Preferred Proposer; or

ii. submitted by other Proposers and made available to the Preferred Proposer prior to the Setting Date;

c. the availability and contents of all Project Information, Department Provided Approvals, the I-70 East EIS and all other available Environmental Approvals, Governmental Approvals, and all other requirements, manuals, guidance, reports, and other information referenced in the Environmental Requirements or the Agreement; and

d. the opportunity to review all Law.

"Reconciliation" has the meaning given to it in Section 15.6.3.

"Reevaluation" means the NEPA evaluation required or prepared pursuant to 23 CFR § 771.129.

"Reference Design" means the preliminary technical blueprint and description of essential design elements for the Project provided as Reference Documents.

"Reference Document" means each of the materials, documents and data listed in Schedule 29 (*Reference Documents*) and made available prior to the Setting Date pursuant to Section 3.1.1.a.

"Refinancing" means:

a. any amendment, variation, novation, supplement or replacement of any Financing Document (other than any Equity Member Funding Agreement);

b. the exercise of any right, or the grant of any waiver or consent, under any Financing Document (other than any Equity Member Funding Agreement);

c. the disposition of any rights or interests in, or the creation of any rights of participation in respect of, any Financing Document (other than any Equity Member Funding Agreement) or the creation or granting of any other form of benefit or interest in either a Financing Document (other than any Equity Member Funding Agreement) or the contracts, revenues or assets of Developer whether by way of security or otherwise; or

d. any other arrangement put in place by Developer or another person which has an effect which is similar to any of a. to c. above or which has the effect of limiting Developer's ability to carry out any of a. to c. above.

"Refinancing Gain" means an amount equal to the greater of zero and an amount equal to (A-B-C), where:

A = the net present value (using the Base Case Equity IRR as the discount rate) of the Distributions projected immediately prior to the Refinancing (taking into account the effect of the Refinancing and using the Financial Model as updated (including as to the performance of the Project) so as to be current immediately prior to the Refinancing) to be made over the remaining term of this Agreement following the Refinancing;

B = the net present value (using the Base Case Equity IRR as the discount rate) of the Distributions projected immediately prior to the Refinancing (but without taking into account the effect of the Refinancing and using the Financial Model as updated (including as to the performance of the Project) so as to be current immediately prior to the Refinancing) to be made over the remaining term of this Agreement following the Refinancing; and

C = any adjustment required to raise the Pre-Refinancing Equity IRR to the Base Case Equity IRR.

"Registered Rating Agency" means a nationally recognized statistical rating organization registered with the Office of Credit Rating of the U.S. Securities and Exchange Commission.

"Related Transportation Facility" means any existing and future bridge, highway, street and road or other transportation facility of any mode, including:

a. directly related component facilities; and

b. upgrades and expansions thereof,

that, in any such case, are or will be connecting with, crossing under or over or otherwise integrated with the Project, and in each case, including for certainty, such facilities on which Department Retained Maintenance is conducted.

"Release" means any emission, spill, seepage, leak, escape, leaching, discharge, injection, pumping, pouring, emptying, dumping, disposal, migration, or release of Hazardous Substances from any source into or upon the Environment.

"Release for Construction Documents" means the drawings (including plans, elevations, sections, details and diagrams), specifications, shop drawings, drawings, samples, reports and calculations approved by Developer for construction as required by Schedule 8 (*Project Administration*).

"Relevant Contract Year" has meaning given to it in Section 2.3.

"Relevant Event" means any Change or a Compensation Event, or any other matter as a result of which this Agreement expressly provides for compensation to be paid by the Enterprises to Developer in respect of any Change in Costs.

"Relevant Milestone Payment Request Due Date" has the meaning given to it in Section 2(a) of Schedule 5 (*Milestone Payments*).

"Relief Event" means:

a. any Force Majeure Event;

b. any:

   i. fire or explosion;

   ii. geomagnetic storm; or

   iii. earthquake;

c. any labor dispute, including a strike, lockout or slowdown, generally affecting the road construction industry in the Denver metropolitan area or a significant sector of it;

d. riot or illegal civil commotion;

e. any Change in Law (excluding any Discriminatory Change in Law);

f. any Unexcused Utility Owner Delay;

g. any Unexcused Railroad Delay;

h. the discovery of any:

   i. Unexpected Historically Significant Remains;

ii. Unexpected Endangered Species;

iii. Unexpected Utility Condition; or

iv. Unexpected Hazardous Substances;

i. any accidental loss or damage to the Right-of-Way, any Additional Right-of-Way or any Permit Areas (excluding Developer-risk Permit Areas) in respect of which Developer holds Permits;

j. the issuance of any temporary restraining order, preliminary or permanent injunction or other form of interlocutory relief by a Governmental Authority under Law that prohibits the prosecution of a material part of the Construction Work;

k. the issuance of a rule, order or directive from the U.S. Department of Homeland Security, the State Department of Public Safety (including the Division of Homeland Security and Emergency Management) or by any Emergency Service regarding specific security threats to the Project or the region within the State in which the Project is located or which the Project serves, to the extent such rule, order or directive:

i. requires specific changes in Developer's normal design, construction, operation or maintenance procedures in order to comply therewith; and

ii. must be complied with by Developer as a matter of Law or otherwise in order to comply with its obligations under this Agreement;

l. any breach by the City of Denver of the Denver IGA that results in:

i. the duration of any street occupancy permit issued by the City of Denver not being for a duration equal to the Reasonable Construction Time Period (as defined in Section 4.A.(iii) of the Denver IGA) plus 10% of that time period; or

ii. the City of Denver unreasonably withholding or delaying any permit that it is required to issue in connection with the Construction Work contrary to Section 4.A.(iv) of the Denver IGA; and

m. any Required Action by the Enterprises that is not taken in response to or because of Developer's breach of its obligations under this Agreement or any Developer Default;

in each case (x) unless such event arises as a result of any breach of Law, Governmental Approval, Permit or this Agreement, or fraud, willful

	misconduct, criminal conduct, recklessness, bad faith or negligence by or of any Developer-Related Entity and (y) excluding any such event that occurs prior to NTP1.
"Relocation Standards"	has the meaning given to it in the applicable URA.
"Renewal Element"	means an Element which has a Useful Life Baseline Requirement specified in Appendix B to Schedule 12 (*Handback Requirements*).
"Renewal Work"	means maintenance, repair, reconstruction, rehabilitation, restoration, renewal or replacement of any Element that is not normally included, in accordance with Good Industry Practice, as an annually recurring cost in maintenance and repair budgets for transportation facilities (and associated equipment) of a similar nature and located in a similar environment to the Project.
"Renewal Work Plan"	means the plan described in Section 6.1 of Schedule 11 (*Operations and Maintenance Requirements*) (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).
"Renewal Work Schedule"	means the schedule required as part of the Renewal Work Plan.
"Representatives"	has the meaning given to it in Section 18.2.1.a.
"Requested Relocation"	means any Utility Relocation of a Private Utility that the relevant Private Utility Owner requests be performed by Developer pursuant to the terms of any URA.
"Required Action"	has the meaning given to it in Section 23.4.3.
"Required Environmental Approvals"	has the meaning given to it in Section 17.6 of Schedule 17 (*Environmental Requirements*).
"Rescue Refinancing"	means a Refinancing by the Lenders upon the occurrence of a default or an event of default under the Funding Agreements.
"Residual Element"	means an Element which has a specified Residual Life Minimum Requirement in Appendix A to Schedule 12 (*Handback Requirements*).
"Residual Life"	means, for an Element, the period remaining until the Element will next require reconstruction, rehabilitation, restoration, renewal or replacement.
"Residual Life at Handback"	means the Residual Life of an Element calculated at the Expiry Date determined through the application of the Residual Life Methodology and Residual Life inspections and by assuming that the Element is subject to maintenance after the Expiry Date to the same standards and requirements, and at the same frequency, as Developer is required to perform Routine Maintenance on such Element in accordance with the terms of this Agreement.

"Residual Life Minimum Requirement"	means, for any Residual Element, the number of years of Residual Life at Handback specified in the "Residual Life at Handback" column for such Residual Element in Appendix A to Schedule 12 (*Handback Requirements*).
"Residual Life Methodology" or "RLM"	means the evaluation and calculation methodology by which the Residual Life of any Element will be calculated at the Expiry Date (including (a) the methodology by which any necessary Renewal Work will be identified and (b) in the case of bridge decks, methodology that complies with the requirements set out in Section 2.1.a of Schedule 12 (*Handback Requirements*)) to ensure that each Residual Element meets or exceeds its Residual Life Minimum Requirement.
"Residual Life Methodology Report"	means the report prepared by Developer in accordance with Section 3.3 of Schedule 12 (*Handback Requirements*).
"Restricted Transfer Period"	means the period commencing on the Agreement Date and ending on (but not including) the second anniversary of the Substantial Completion Date.
"Reviewable Deliverable"	means any Deliverable that is a Deliverable for Approval, a Deliverable for Acceptance or a Deliverable for Information.
"Revised Baseline Schedule"	means the then current revision to the Baseline Schedule (including to any prior Revised Baseline Schedule), which has been submitted by Developer and Approved by the Enterprises pursuant to Section 3.3.4.b of Schedule 8 (*Project Administration*).
"RFP"	has the meaning given to it in the Recitals.
"Right-of-Way"	means, collectively, all of the land, improvements and fixtures that are located within all ROW Parcels, but in each case with effect only from the Project License Start Date and only until the Project License End Date, in each case, for the relevant ROW Parcel.
"Right-of-Way Betterment"	means appreciation in the value of a property due to beneficial public works executed in its near vicinity.
"Right-of-Way Relocation"	means displacing a current resident or occupant to a new location.
"ROD"	has the meaning given to it in the Recitals.
"Routine Maintenance"	means maintenance activities that are scheduled in advance and occur on a regular basis, such as weekly, monthly, quarterly, semi-annually or annually, which are normally included as an annually recurring cost in maintenance and repair budgets for transportation facilities (and associated equipment) of similar natures and in similar environmental conditions as the Project.
"ROW Parcel"	means each parcel of land referred to in the "Developer's Parcel" column in the ROW Schedule, each as identified in the Right-of-Way Exhibits in the Contract Drawings.
"ROW Schedule"	means the table set out in Appendix A to Schedule 18.

"RRA" means any of:

a. the BNSF RRA;

b. the DRIR RRA;

c. the UPRR RRA; and

d. the UPRR Pepsi Lead RRA.

"Safety Compliance" means any and all improvements, repair, reconstruction, rehabilitation, restoration, renewal, replacement and/or changes in configuration or procedures in relation to the Project to correct a specific safety condition or risk in relation to the Project that the Enterprises, CDOT or another Governmental Authority have reasonably determined to exist.

"Safety Compliance Order" means a written order or directive from the Enterprises to Developer to implement Safety Compliance, provided that such order or directive shall not be used to effect a change to the Technical Requirements or the Project Standards or safety-related portions of the Work affected by a Change in Law.

"Second Handback Inspection Report" means the report prepared by Developer in accordance with Section 3.11.a.i and 3.11.b of Schedule 12 (*Handback Requirements*).

"Security Documents" means:

a. the documents listed in the Lenders Direct Agreement executed on or about the Financial Close Date; and

b. any other mortgage, deed of trust, guarantee, pledge, lien, indenture, trust agreement, hypothecation, assignment, collateral assignment, financing statement under the Uniform Commercial Code of any jurisdiction, security instrument or other charge or encumbrance of any kind, including any lease in the nature of a security instrument, given to any Lender as security for Project Debt or Developer's obligations pertaining to Project Debt to the extent permitted by this Agreement.

"Service Line" means:

a. a Utility line, the function of which is to directly connect the improvements on an individual property to another Utility line located off such property, which other Utility line connects more than one such individual line to a larger system; or

b. a Utility line on public or private property that services structures located on such property.

"Setting Date" means [*the date one Calendar Month prior to the Technical Proposal Deadline*].

"Site"	means, at any time: a. the Right-of-Way; b. any Additional Right-of-Way; c. any Permit Areas in respect of which Developer holds Permits at that time; and d. any Temporary Properties in respect of which Developer owns or holds Temporary Property Rights at that time.
"Snow and Ice Control Equipment"	has the meaning given to it in Section 11.6 of Schedule 11 (*Operations and Maintenance Requirements*).
"Snow and Ice Control Plan"	means the plan described in Section 9.3 of Schedule 11 (*Operations and Maintenance Requirements*).
"Snow and Ice Control Services"	means the snow and ice control services as described in Section 11 of Schedule 11 (*Operations and Maintenance Requirements*).
"Snow Route"	means the documented configuration and path(s) traversed by a snowplow or Spreader documented in Developer's Snow and Ice Control Plan.
"Special Events"	means events expected to produce higher than average traffic on the I-70 East Corridor.
"Special Permit"	means a Permit issued by CDOT to permit a Person with a right under Law to have access to the Right-of-Way and any Additional Right-of-Way for a purpose which does not include carrying out any excavation in order to exercise that right.
"Special Provisions"	means Sections 36, 46.1 and 53.[25]
"Specialist Inspections"	means inspections of specified Elements or components for which testing, special tools or equipment are necessary, including inspections required to be undertaken in accordance with Section 8.4 of Schedule 11 (*Operations and Maintenance Requirements*).
"Spreader"	means a vehicle capable of spreading salt, de-icers and anti-icers.
"Standard Specifications"	means the CDOT *Standard Specifications for Road and Bridge Construction 2011.*
"State"	means the State of Colorado.
"Storm Drain"	means a network of pipes that connects inlets, manholes, and other drainage features to an outfall.
"Subcontract"	means any contract (at any tier) entered into by Developer, the Construction Contractor, the O&M Contractor or a Subcontractor including a Supplier with one or more third parties directly in connection with the

[25] The list of State required Special Provisions remains under review by the Attorney General's office, in consultation with the office of the Colorado State Controller.

	carrying out of the Work or any of Developer's other obligations under this Agreement.
"Subcontractor"	means any party, other than Developer, to a Subcontract.
"Substantial Completion"	[*To be provided in a subsequent Addendum*.]
"Substantial Completion Certificate"	[*To be provided in a subsequent Addendum*.]
"Substantial Completion Conditions"	[*To be provided in a subsequent Addendum*.]
"Substantial Completion Date"	[*To be provided in a subsequent Addendum*.]
"Substantial Completion Deduction Amount"	means the amount calculated in accordance with Section 1 of Part 1 of Schedule 6 (*Performance Mechanism*).
"Substantial Completion Delay Period"	has the meaning given to it in Section 15.6.1.
"Substantial Completion Milestone Payment"	means the Milestone Payment payable in respect of the achievement of Substantial Completion.
"Substantial Completion Payment"	has the meaning given to it in Section 3(b) of Schedule 5 (*Milestone Payments*).
"Substantial Completion Punch List"	[*To be provided in a subsequent Addendum*.]
"Substantial Completion Punch List Items"	[*To be provided in a subsequent Addendum*.]
"Supervening Event"	means any Relief Event and any Compensation Event.
"Supplied Survey Data"	means the survey data for the Construction Work identified in the Reference Documents.
"Supplier"	means a Subcontractor that primarily provides goods and/or materials, but not services, under the terms of its Subcontract.
"Table 6A.1"	means Table 6A.1 set out in Appendix A to Schedule 6 (*Performance Mechanism*).
"Table 6A.2"	means Table 6A.2 set out in Appendix A to Schedule 6 (*Performance Mechanism*).
"Target"	means, in respect of an Element, the condition of such Element specified in the "Target" column in the Performance and Measurement Tables (as updated in accordance with Schedule 11 (*Operations and Maintenance Requirements*)).

"Technical Proposal Deadline"	means [ ].[26]
"Technical Requirements"	means the obligations of, and any requirements to be satisfied by, Developer under any of Schedules 8 (*Project Administration*), 9 (*Submittals*), 10 (*Design and Construction Requirements*), 11 (*Operations and Maintenance*), 12 (*Handback Requirements*), 17 (*Environmental Requirements*) and 18 (*Right-of-Way*) and Table 6A.1 and Table 6A.2.
"Temporary Easement"	means any temporary easement in an area that is outside the Right-of-Way or any Additional Right-of-Way, but which is required for performing Construction Work within the Right-of-Way or any Additional Right-of-Way.
"Temporary Property"	means: a. Temporary Easements; and b. other areas not within the Right-of-Way or any Additional Right-of-Way in which Developer is performing Work for a temporary period, such as temporary Construction Work sites, lay down areas, staging areas, storage areas, stockpiling areas, earthwork material borrow sites, equipment parking areas and similar areas.
"Temporary Property Rights"	means, in respect of any Temporary Property, any right or interest in, or in respect of, such Temporary Property.
"Term"	has the meaning given to it in Section 4.2.
"Termination Amount"	means, with respect to any termination of this Agreement prior to the Expiry Date, the amount of compensation, if any, owing from the Enterprises to Developer as determined pursuant to this Agreement.
"Termination by Court Ruling"	means the issuance of a final, non-appealable court order by a court of competent jurisdiction: a. to the effect that this Agreement is void and/or unenforceable or impossible to perform in its entirety (except by reason of a Developer-Related Entity's acts or omissions, fraud, willful misconduct, criminal conduct, recklessness, bad faith or negligence, breach of this Agreement or violation of Law or an applicable Governmental Approval or Permit); b. permanently enjoining or prohibiting performance or completion of a material portion of the Work (except by reason of a Developer-Related Entity's acts or omissions, fraud, willful misconduct, criminal conduct, recklessness, bad faith or negligence, breach of this Agreement or violation of Law or an applicable Governmental Approval or Permit); c. requiring the Enterprises or CDOT, individually, or in

[26] To be inserted prior to execution of this Agreement.

concert with one another and/or the FHWA, to undertake additional or supplemental evaluations, studies or other work under NEPA that, in the Enterprises' discretion, is impracticable in light of the purpose and intent of this Agreement; or

d. upholding the binding effect on Developer or the Enterprises and/or CDOT of a Change in Law that causes impossibility of performance of a fundamental obligation by Developer or the Enterprises under this Agreement or impossibility of exercising a fundamental right of Developer or the Enterprises under this Agreement.

"Termination Date" means the effective date of any early termination of this Agreement as determined pursuant to Schedule 1 (*Financial Close*) or Sections 33.1.2 through 33.1.7, as applicable.

"Termination for Convenience" has the meaning given to it in Section 33.1.2.a.

"Termination for Extended Force Majeure" has the meaning given to it in Section 33.1.6.a.

"Termination Notice" means a notice of termination issued pursuant to Section 33.1.

"Test" or "Testing" means the procedure and method of acquiring and recording physical data and comparing it to set standards and submitting a statement to such conditions or operations as will lead to its Acceptance or rejection (deficiency, defective condition, nonconformance) of the item.

"Third Handback Inspection Report" means the report prepared by Developer in accordance with Sections 3.11.a.ii and 3.11.b of Schedule 12 (*Handback Requirements*).

"Third Party Agreements" means:

a. the URAs;

b. the RRAs;

c. the Denver IGA;

d. the E-470 TSA; and

e. [*possibility of additional IGAs under review*].

"Threshold Zone" means the length of roadway between the Portal and the Transition Zone.

"TIFIA" means the Transportation Infrastructure Finance and Innovation Act of 1998, codified at 23 U.S.C. §.601 et seq.

"TIFIA Loan" means a loan from the US DOT pursuant to the federal credit assistance program established pursuant to TIFIA.

"Tolled Express Lane" means the lanes on the I-70 Mainline where operational strategies are proactively implemented and managed in response to changing

conditions.

"Tow Plow" means a snow plow blade mounted on a ballasted trailer that is towed behind a conventional plow or combination plow/spreader truck, where controls in the towing vehicle deploy the tow plow into an adjacent lane, permitting two lanes to be plowed by a single tow vehicle.

"Transferrable Assets" means all Assets, including all transferrable warranties with respect to such Assets, except:

a. if and only if the benefit of a Principal Subcontract is transferred to the Enterprises or another Person designated by them, for those Assets described in paragraphs c. and e. of the definition of "Assets" that are not owned or operated by such Principal Subcontractor exclusively for the purposes of the Project; and

b. any Temporary Properties, and any buildings located on such properties.

"Transition Zone" means the length of roadway between the Threshold Zone and the Interior Zone and which has variable illumination depending upon the illumination in the Threshold Zone to allow adaption to the Interior Zone illumination, and the length of which is determined by the posted vehicle speed

"Transportation Commission" has the meaning given to it in the Recitals.

"Transportation Demand Model" means a program that encompasses tools to help with traffic congestion mitigation by offering alternatives to the single occupant vehicle.

"Transportation Management Plan" means, from time to time, the then current plan that satisfies the requirements of Section 2.2.3 of Schedule 10 (*Design and Construction Requirements*) and has been submitted by Developer and Accepted by the Department pursuant to Schedule 10 (*Design and Construction Requirements*).

"Travel Time Indicators" means the system of antennas and readers that detect toll tag transponders in vehicles.

"Ultimate" has the same meaning as given to the Preferred Alternative.

"Unexcused Railroad Delay" means:

a. any unexcused delay (as determined by reference to the relevant RRA) by a Railroad in performing any work required to performed by it under such agreement; or

b. any breach of a RRA by a Railroad.

"Unexcused Utility Owner Delay" means:

a. any unexcused delay (as determined by reference to the relevant URA and/or relevant Utility Work Order) by a Utility Owner in performing any work under a URA and/or

a Utility Work Order; or

b. any breach of a URA or Utility Work Order by a Utility Owner.

"Unexpected Endangered Species" means any animal or plant species listed as threatened or endangered under and subject to an applicable threatened or endangered species Law found at the Right-of-Way, or at any Permit Areas (excluding Developer-risk Permit Areas) in respect of which Developer holds a Permit, the temporary, continual or habitual presence of which on the Right-of-Way or any such Permit Area was not Known or Knowable at the Setting Date.

"Unexpected Geological Conditions" means any subsurface or latent geological conditions encountered at the exact bore hole locations identified in:

a. the boring logs set out in Appendices B and D1 of the Final Preliminary Subsurface Investigation Report I-70 East Corridor Project Partial Cover Lowered Alternative with Managed Lanes Options Brighton Boulevard to Chambers Road Denver, Colorado CDOT Project No: FBR 0709-234 (19631) prepared by Yeh and Associate, Inc. dated September 21, 2015; and

b. the boring logs on pages 25 to 59 of the Preliminary Subsurface Investigation Report for Partial Cover Lowered (PCL) Alternative I-70 East Corridor EIS CDOT Region 6 prepared by Yeh and Associates, Inc. dated October 31, 2012,

in each case that differ materially from those conditions indicated in such boring logs for such bore hole locations, which conditions were not Known or Knowable at the Setting Date.

"Unexpected Hazardous Substances" means any Hazardous Substances (including soil or water contaminated with Hazardous Substances) present on, in or under any part of the Right-of-Way, or of any Permit Areas (excluding Developer-risk Permit Areas) in respect of which Developer holds a Permit, at concentration levels or in quantities that are required to be investigated, removed, managed or remediated pursuant to Law or Developer's obligations under this Agreement, the presence of which was not Known or Knowable at the Setting Date.

"Unexpected Historically Significant Remains" means any antiquities, fossils, coins, articles of value, cultural artifacts, human burial sites and remains and other similar remains of archaeological, cultural or paleontological interest on or under any part of the Right-of-Way, or of any Permit Areas (excluding Developer-risk Permit Areas) in respect of which Developer holds a Permit, which were not Known or Knowable at the Setting Date.

"Unexpected Utility Condition" means any Utility present on the Right-of-Way, or on any Permit Areas (excluding Developer-risk Permit Areas) in respect of which Developer holds a Permit, that was not identified or was incorrectly shown, identified or described in the Utility Data, in each case excluding:

a. any Utility to the extent it was Known or Knowable, which for such purposes shall be deemed to include any Utility that:

i. is located at or less than 10 feet distant from the horizontal centerline indicated therefor in the Utility Data (without regard to vertical location); and/or

ii. has an actual nominal diameter (excluding casings and any other appurtenances) within 12 inches of the size indicated in the Utility Data;

b. any Utility installed on any part of the Right of Way after the Project License Start Date, or on any Permit Area after Developer secured a Permit providing access and/or use to or of such area; and

c. any Service Line.

"Uniform Act" means the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act, P.L. 91-646.

"UPRR" means Union Pacific Railroad Company.

"UPRR Crossing" means the existing and/or proposed crossing by the UPRR Railroad through the I-70 East corridor on the Right-of-Way as described in Section 10.1.2 of Schedule 10 (*Design and Construction Requirements*).

"UPRR Pepsi Lead Crossing" means the existing and/or proposed crossing of Brighton Boulevard by the UPRR Pepsi Lead Railroad through the I-70 East corridor on the Right-of-Way as described in Section 10.1.3 of Schedule 10 (*Design and Construction Requirements*).

"UPRR Pepsi Lead RRA" means the railroad agreement with respect to the UPRR Pepsi Lead Crossing between CDOT and UPRR dated [ ].

"UPRR RRA" means the railroad agreement with respect to the UPRR Crossing between CDOT and UPRR dated [ ].

"UPRR Work" means all duties and services to be furnished and provided by the UPRR as required by the UPRR RRA and the UPRR Pepsi Lead RRA, as applicable.

"URA" means the utility relocation agreements (copies of each of which were provided in the Reference Documents) between CDOT and each of the Publicly Owned Utilities and the Private Utility Owners.

"US DOT" means the United States Department of Transportation.

"Useful Life" means, for an Element, the period following its first construction or installation, or following its last reconstruction, rehabilitation, restoration, renewal or replacement, until the Element will next require reconstruction, rehabilitation, restoration, renewal or replacement.

"Useful Life Baseline Requirement"	means, for any Renewal Element, the number of years specified in the "Useful Life" column for such Renewal Element in Appendix B to Schedule 12 (*Handback Requirements*).
"Useful Life Baseline Requirements Table"	means the table set out in Appendix B to Schedule 12 (*Handback Requirements*) (as updated in accordance with Section 6.1.4 of Schedule 11 (*Operations and Maintenance Requirements*)).
"User"	means any person that is on or about the Project or any portion thereof, or is otherwise making use of the Project for any purpose.
"Utility"	means a privately, publicly or cooperatively owned line, facility and/or system for producing, transmitting or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, or any other similar commodity including: a. the necessary appurtenances to any such line, facility and/or system; and b. any Service Line connecting directly to any such line, facility and/or system, regardless of the ownership of such Service Line; provided that, for certainty, stormwater facilities, irrigation ditches, Intelligent Transportation Systems, Variable Message Signs, video and video detection systems, traffic signals and street lighting shall not constitute "Utilities".
"Utility Betterment"	has the meaning given to "Betterment" in the applicable URA.
"Utility Data"	means the Utility Drawings, the Utility Matrix, pothole log, manhole tabulation and other Utility information provided in the Reference Documents.
"Utility Drawings"	means the Utility plan design sheets provided in the Reference Documents, as updated from time to time by Developer pursuant to Section 4 of Schedule 10 (*Design and Construction Requirements*).
"Utility Matrix"	means the Construction Work "Utility Matrix" provided in the Reference Documents, as updated from time to time by Developer pursuant to Section 4.3.2.c of Schedule 10 (*Design and Construction Requirements*).
"Utility No-Conflict Close Out Form"	means the form provided in Appendix A of Section 4 to Schedule 10 (*Design and Construction Requirements*).
"Utility Owner"	means the owner of a Utility.
"Utility Permit"	means a Permit issued by CDOT to permit a Utility Owner with a right under Law to have access to the Right-of-Way and any Additional Right-of-Way in order to exercise that right.
"Utility Relocation"	has the meaning given to "Relocation" in the applicable URA.
"Utility Relocation	has the meaning given to "Relocation Standards" in the applicable URA.

Standards"

"Utility Work"	means any portion of Construction Work relating to Utility Relocations, Betterments or Requested Relocations, including but not limited to the Activities listed in Section 4.2.10 of Schedule 10 (*Design and Construction Requirements*).
"Utility Work Order"	has the meaning given to "Work Order" in the applicable URA and shall be substantially in the form provided in Appendix B of Section 4 to Schedule 10 (*Design and Construction Requirements*).
"Variable Message Sign"	means the large dynamic display used for user alerts and notifications.
"Variable Toll Message Sign"	means the static sign with electronic Variable Message Sign inserts that is utilized to display the specific tolls for each segment of the corridor.
"Warrantied Elements"	means the Elements of the Construction Work to be maintained by any of the Warranty Beneficiaries after Substantial Completion.
"Warranties"	has the meaning given to it in Section 9.4.1.
"Warranty Beneficiaries"	has the meaning given to it in Section 9.4.2.a.
"Warranty Defects List"	has the meaning given to it in Section 9.4.5.
"Warranty Period"	has the meaning given to it in Section 9.4.3.
"Weekend"	means the 48 hour period commencing on a Saturday at 12.00am and ending on the next Sunday at 11.59pm.
"Work"	means all of the work and services and performance of obligations, or any of it, to be undertaken or provided by Developer pursuant to this Agreement, including Construction Work and O&M Work.
"Work Breakdown Structure"	means the organized hierarchical division of Activities which shall be the basis for organizing all Work, as described in this Agreement. Requirements for the Work Breakdown Structure are set out in Schedule 8 (*Project Management*).
"Working Day"	means any Calendar Day that is not a Saturday, a Sunday or Holiday.

Part B: Abbreviations

Except as otherwise specified herein or as the context may otherwise require, the following abbreviations set out below are provided as references for purposes of the Technical Requirements, Table 6A.1 and Table 6A.2 only:

"ABC"	means aggregate base course.
"AC"	means alternating current.
"ACL"	means access control list.
"ADA"	means Americans with Disabilities Act.
"AID"	means automatic incident detection.
"AHJ"	means Authority Having Jurisdiction.
"ALPR"	means Automatic License Plate Recognition.
"AMCA"	means Air Movement and Control Association.
"ANSI"	means American National Standards Institute.
"APCD"	means Air Pollution Control Division.
"APEN"	means Air Pollution Emission Notice.
"AREMA"	means American Railway Engineering and Maintenance-of-Way Association.
"ATM"	means Active Traffic Management.
"ATR"	means Automatic Traffic Recorders.
"AVI"	means Automatic Vehicle Identification.
"AVL"	means Automated Vehicle Locator.
"BACR"	means Baseline Asset Condition Report.
"BMP"	means Best Management Practices.
"CCD"	means City and County of Denver.
"CCMS"	means Command, Control, and Monitoring System.
"CCP"	means Crisis Communications Plan.
"CCTV"	means Closed Circuit Television.
"CDPHE"	means Colorado Department of Public Health and Environment.
"CDPS"	means Colorado Discharge Permit System.
"CDPS-SCP"	means Colorado Discharge Permit System-Stormwater Construction Permit.
"CFD"	means Computational Fluid Dynamics Model.
"CLOMR"	means Conditional Letter of Map Revision.
"CMS"	means cable management system.
"COTS"	means conventional, off-the-shelf.
"CPCM"	means Construction Process Control Manager.
"CPM"	means Critical Path Method.
"CPW"	means Colorado Parks and Wildlife.
"CRAL"	means Construction of Relocation Acceptance Letter.
"CSL"	means cross sonic log.
"CSP"	means Colorado State Patrol.
"CTMC"	means Colorado Transportation Management Center.
"CTMS"	means Colorado Transportation Management Software.
"CUHP/EPA-SWMM"	means Colorado Urban Hydrograph Procedure/Environmental Protection Agency Storm Water Management Model.
"CWCP"	means Construction Work Communications Plan.
"CWDM"	means coarse wavelength division multiplexing.
"CVS"	means Cover Ventilation System.
"DBE"	means Disadvantaged Business Enterprise.
"DCS"	means Document Control System.
"DPCM"	means Design Process Control Manager.
"DRAL"	means Design of Relocation Acceptance Letter.
"DRIRR"	means Denver Rock Island Railroad.
"DTD"	means Division of Transportation Development.
"DWDM"	means dense wavelength division multiplexing.
"ECS"	means Erosion Control Supervisor.

"ECWP" means Environmental Compliance Work Plan.
"EDB" means extended detention basins.
"EDP" means electrical distribution panels.
"EIS" means Environmental Impact Statement.
"EM" means Environmental Manager.
"EPA" means Environmental Protection Agency.
"ERP" means Emergency Response Plan.
"ESAL" means 18-kip Equivalent Single Axle Loads.
"ESB" means Emerging Small Business.
"ETC" means Electronic Toll Collection.
"FCM" means fracture critical member.
"FDAS" means Fire Detection and Alarm System.
"FDS" means Functional Design Specification.
"FEE" means Fee interest or ownership of the fee simple estate in real property.
"FEIS" means Final Environmental Impact Statement.
"FEMA" means Federal Emergency Management Agency.
"FFFS" means Fixed Firefighting System.
"FMV" means Fair Market Value.
"GUI" means graphical user interface.
"GPS" means Global Positioning System.
"HBP" means hot bituminous pavement.
"HDPE" means high-density polyethylene.
"HGL" means hydraulic grade line.
"HLMR" means high load multi-rotational.
"HMA" means hot mix asphalt.
"HOV" means high occupancy vehicle.
"HVAC" means heating, ventilation, and air conditioning.
"IA" means Independent Assurance.
"IAR" means Interstate Access Request.
"IBC" means International Building Code.
"IDQM" means Independent Design Quality Manager.
"IESNA" means Illumination Engineering Society North America.
"IGMP" means Internet Group Management Protocol.
"IMP" means Incident Management Plan.
"IQC" means Independent Quality Control.
"IQCF" means Independent Quality Control Firm.
"IQCM" means Independent Quality Control Manager.
"INWMP" means Integrated Noxious Weed Management Plan.
"IP" means Internet Protocol.
"IRI" means International Roughness Index.
"ISO" means International Organization for Standardization.
"ITS" means Intelligent Transportation Systems.
"IVR" means Interactive Voice Response.
"LCD" means Liquid Crystal Display.
"LED" means light emitting diode.
"LEP" means Limited English Proficient.
"LFD" means load factor design.
"LFR" means a load factor rating.
"LOMR" means Letter of Map Revision.
"LP" means Lighting Protection.
"LRFD" means load resistance factor design.
"LRFR" means aggregate base course.
"LSOH" means low smoke, zero halogen.
"LUS" means Lane Use Signal.
"M-E" means mechanistic-empirical.
"MBTA" means Migratory Bird Treaty Act.

"MEP" means mechanical, electrical, and plumbing.
"MHCP" means Mile High Courtesy Patrol.
"MHT" means Methods of Handling Traffic.
"MMP" means Materials Management Plan.
"MMP" means Maintenance Management Plan (in the context of O&M Work).
"MMIS" means Maintenance Management Information System.
"MOCP" means Maintenance and Operations Communications Plan.
"MOT" means maintenance of traffic.
"MVRD" means Microwave Vehicle Radar Detection.
"MS4" means Municipal Separate Storm Sewer System.
"MSE" means mechanically stabilized earth.
"MTIP" means Materials Testing and Inspection Plan.
"MW" means megawatts.
"NCN" means Nonconformance Notice.
"NCHRP" means National Cooperative Highway Research Program.
"NCR" means Nonconformance Report.
"NDRD" means New Development Redevelopment.
"NEC" means National Electric Code.
"NEPA" means the National Environmental Policy Act.
"NFPA" means National Fire Protection Association.
"NIOSH" means National Institute for Occupational Safety and Health.
"NIST" means National Institute of Standards and Technology.
"NSBA" means National Steel Bridge Alliance.
"NTCIP" means National Transportation Communications for ITS Protocol.
"NTP" means Notice to Proceed.
"O&M" means Operations and Maintenance.
"OCR" means Optical Character Recognition.
"OJT" means On the Job Training.
"OMP" means Operations Management Plan.
"OMQMP" means O&M Quality Management Plan.
"OTIS" means Online Transportation Information System.
"PA" means Public Address.
"PC" means Process Control.
"PCCP" means Portland cement concrete pavement.
"PCM" means Project Communications Manager.
"PDA" means Pile Driving Analyzer.
"PE" means Permanent Easement.
"PIARC" means Permanent International Association of Road Congresses.
"PIP" means Public Information Plan.
"PLC" means programmable logic controller.
"PoE" means Power over Ethernet.
"PMP" means Project Management Plan.
"PNS" means Pacific Northwest Snow Fighters.
"POSS" means Point of Slope Selection.
"PQM" means Project Quality Manager.
"PSQF" means Permanent Stormwater Quality Facilities.
"PTFE" means polytetrafloroethylene.
"PTI" means Post-Tensioning Institute.
"PUC" means Public Utility Commission.
"PVC" means polyvinyl chloride.
"QC" means Quality Control.
"QMP" means Quality Management Plan.
"QMS" means Quality Management System.
"QRD" means Quality Records Database.
"RAP" means Recycled Asphalt Pavement.
"REC" means Recognized Environmental Condition.

"RFC"	means Release for Construction.
"RFP"	means Request for Proposals.
"RHM"	means Recognized Hazardous Material.
"ROD"	means Record of Decision.
"ROW"	means Right-of-Way.
"RPM"	means Reflective Pavement Markers.
"RTD"	means Regional Transportation District.
"RTK"	means Real Time Kinematic.
"RTM"	means Requirements Traceability Matrix.
"RWIS"	means Road Weather Information System.
"SAP"	means Sampling Analysis Plan.
"SB"	means Colorado Senate Bill.
"SCADA"	means Supervisory Control and Data Acquisition.
"SCP"	means Stormwater Construction Permit.
"SFP"	means small form-factor pluggable.
"SMA"	means stone matrix asphalt.
"SMFO"	means Single-Mode Fiber Optic.
"SMP"	means Safety Management Plan.
"SMVMS"	means Side Mounted Variable Message Signs.
"SOLIT"	means Safety of Life in Tunnels.
"SOV"	means single occupancy vehicle.
"SPCC"	means Spill Prevention Control and Countermeasures.
"TCP"	means Temporary Traffic Control Plan.
"TDC"	means Traffic Data Collection Unit.
"TDM"	means Travel Demand Management.
"TE"	means temporary easement.
"TMOSS"	means Terrain Modeling Survey System.
"TMP"	means Transportation Management Plan.
"TOP"	means Transportation Operations Plan.
"TSS"	means total suspended solids.
"TTI"	means Travel Time Indicators.
"UBC"	means Uniform Building Code.
"UDFCD"	means Urban Drainage and Flood Control District.
"UE"	means Utility easements.
"UNCC"	means Utility Notification Center of Colorado.
"UPRR"	means Union Pacific Railroad.
"UPS"	means Uninterruptible Power Supply.
"URA"	means Utility Relocation Agreement.
"USFWS"	means U.S. Fish and Wildlife Service.
"VA"	means Voice Alarm.
"VCS"	means ventilation control system.
"VFD"	means Vacuum Fluorescent Display.
"VMS"	means Variable Message Sign.
"VTMS"	means Variable Toll Message Sign.
"WBS"	means a Work Breakdown Structure.
"WDP"	means Workforce Development Plan.
"WQCV"	means Water Quality Capture Volume.

Schedule 1
Financial Close

[*To be provided in a subsequent Addendum*]

Schedule 2
Representations and Warranties

[*To be provided in a subsequent Addendum*]

Schedule 3
Commencement and Completion Mechanics

[*To be provided in a subsequent Addendum*]

Schedule 4
Payments

Part 1: Construction Period

1. Milestone Payments

The Enterprises shall pay the Milestone Payments to Developer in accordance with Schedule 5 (*Milestone Payments*) in respect of Construction Work carried out during the Construction Period.

2. Monthly Deductions Reports

2.1 Developer shall submit to the Enterprises, no later than the tenth Calendar Day (or, if such day is not a Working Day, the first Working Day after the tenth Calendar Day) in each month that commences after the Financial Close Date (or, if earlier, the date of issuance of NTP1) and prior to the Substantial Completion Date (other than the first such month, if the earlier of such dates occurs before the tenth Calendar Day of such month), a report that complies with the requirements of Section 2.2 of this Part 1

2.2 Each Monthly Deductions Report required to be submitted to the Enterprises pursuant to Section 2.1 of this Part 1 shall be in a form agreed by the Parties (acting reasonably) and shall contain the following information in relation to (unless expressly provided otherwise in this Section 2.2) the month that immediately precedes the month in which such Monthly Deductions Report is required to be submitted:

(a) details of:

(i) each Noncompliance Event (including the nature of such event, its Noncompliance Start Time and, if such time has occurred at the date of such report, its Noncompliance Rectification Time) that accrued Noncompliance Points in the CP Deduction Month in accordance with Table 6A.1 and Part 4 of Schedule 6 (*Performance Mechanism*); and

(ii) the number of Noncompliance Points that accrued in respect of each such Noncompliance Event in the CP Deduction Month (including details of how such number was calculated),

provided that, for certainty, in relation to any Noncompliance Event that occurred in (A) a month prior to the CP Deduction Month but which continued to subsist during the CP Deduction Month or (B) the CP Deduction Month but which continued to subsist after the end of the CP Deduction Month, the number of Noncompliance Points reported pursuant to this Section 2.2(a) shall be solely the number that accrued in the CP Deduction Month in accordance with Section 3 of Part 4 of Schedule 6 (*Performance Mechanism*);

(b) the aggregate number of Noncompliance Points that accrued in the CP Deduction Month in respect of all Noncompliance Events in accordance with Table 6A.1 and Part 4 of Schedule 6 (*Performance Mechanism*);

(c) the calculation of the Monthly Noncompliance Deduction for the CP Deduction Month;

(d) the cumulative total of Monthly Noncompliance Deductions for all months up to and including the CP Deduction Month;

(e) details of:

(i) each Non-Permitted Construction Closure (including the cause thereof, its start time and, if such time has occurred at the date of such report, its end time) that resulted in the accrual of one or more Construction Closure Deductions in the CP Deduction Month in accordance with Section 3 of Part 1 of Schedule 6 (*Performance Mechanism*); and

(ii) the amount of such Construction Closure Deductions that accrued in respect of each such Non-Permitted Construction Closure in the CP Deduction Month (including details of how such amount was calculated),

provided that, for certainty, in relation to any Non-Permitted Construction Closure that commenced in (A) a month prior to the CP Deduction Month but which continued to subsist during the CP Deduction Month or (B) the CP Deduction Month but which continued to subsist after the end of the CP Deduction Month, the amount of Construction Closure Deductions reported pursuant to this Section 2.2(e) shall be solely the number that accrued in the CP Deduction Month in accordance with Section 3.2(b) of Part 1 of Schedule 6 (*Performance Mechanism*);

(f) the calculation of the Monthly Construction Closure Deduction for the CP Deduction Month;

(g) the cumulative total of Monthly Construction Closure Deductions for all months up to and including the CP Deduction Month;

(h) the aggregate of the amounts referred to in Sections 2.2(c) and (f) of this Part 1;

(i) the aggregate of the amounts referred to in Sections 2.2(d) and (g) of this Part 1;

(j) sufficient information to enable the Enterprises to determine whether any of the Noncompliance Default Events specified in paragraph a. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*), or any of the Increased Oversight Thresholds specified in paragraph a. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*), have occurred, which information shall include:

(i) the cumulative number of Noncompliance Points accrued during each of the [12] month period and the [36] month period ending at the end of the CP Deduction Month; and

(ii) the cumulative number of Noncompliance Events which have a Grace Period cured during the applicable Grace Period during the [12] month period and the [36] month period ending at the end of the CP Deduction Month;

(k) sufficient information to enable the Enterprises to determine whether either of the Closure Default Events specified in paragraph a. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*) has occurred, which information shall include the cumulative amount of Construction Closure Deductions accrued during the [12] month period and the [36] month period ending at the end of the CP Deduction Month; and

(l) such other information as may reasonably be requested by the Enterprises.

2.3 The Enterprises shall notify Developer in writing (with reasons and any supporting documentation available to the Enterprises) within ten Working Days of receipt of any such Monthly Deductions Report if there is any part of such report which the Enterprises dispute, provided that a failure by the Enterprises to notify Developer of a Dispute within such period shall not constitute a waiver of their rights to do so at a later date.

2.4 If the Parties agree or it is determined pursuant to the Dispute Resolution Procedures that any Monthly Deductions Report was incorrect or inaccurate, then Developer shall be required (if requested by the Enterprises) to submit a corrected report and shall, in any event, reflect such correction, as appropriate, in the next Monthly Deductions Report to be submitted to the Enterprises pursuant to Section 2.1 of this Part 1 after the Parties reach agreement or the Dispute is resolved, provided that, in the event that any such inaccuracy is identified or Dispute resolved after payment of the Substantial Completion Payment, the Developer shall be required to reflect the necessary adjustment, as appropriate, in the next Payment Request submitted to the Enterprises after identification of such inaccuracy or resolution of such Dispute.

Part 2: Operating Period

1. Performance Payments

The Enterprises shall pay Performance Payments to Developer during the Operating Period, as calculated in accordance with Part 2 of Schedule 6 (*Performance Mechanism*).

2. Payment Requests

2.1 No later than the tenth Calendar Day (or, if such day is not a Working Day, the first Working Day after the tenth Calendar Day) in each Payment Month (other than the First Payment Month if the Substantial Completion Date occurs after the tenth Calendar Day of such month), Developer shall submit a payment request for the Performance Payment payable in respect of the Payment Month in which such payment request is submitted, together with a Monthly Deductions Report in accordance with Section 3 of this Part 2.

2.2 If the Substantial Completion Date occurs after the tenth Calendar Day of the First Payment Month, Developer shall submit a separate Payment Request for the Performance Payment payable in respect of the First Payment Month at the same time as, pursuant to Section 2.1 of this Part 2, it submits a Payment Request for the Performance Payment payable in respect of the second Payment Month.

2.3 Each Payment Request shall set out:

(a) the amount of the Performance Payment payable in respect of the relevant Payment Month;

(b) the agreed or determined amount of any Monthly Noncompliance Deductions and/or Operating Period Closure Deductions that accrued in any month prior to the relevant Payment Month which have not been reflected in any prior Payment Request (including as a result of the accrual or amount thereof having been in dispute);

(c) any amount required to be reflected in such Payment Request pursuant to the proviso to Section 2.4 of Part 1 of this Schedule 4;

(d) if such Payment Request is in respect of the First Payment Month and the Substantial Completion Deduction Amount exceeded the Substantial Completion Milestone Payment, an amount equal to such excess, provided that each Payment Request submitted after such Payment Request shall include any portion of such amount that has not been taken into account in a prior Payment Request;

(e) any other amounts due under this Agreement from Developer to the Enterprises or from the Enterprises to Developer and not previously included in a Payment Request or Milestone Payment Request;

(f) any adjustments to reflect over-payments and/or under-payments (each such adjustment stated separately) of any amount due prior to the relevant Payment Month (for which adjustment has not already been made);

(g) any interest payable by the Enterprises or the Developer in respect of any amount that previously became payable to, respectively, Developer or the Enterprises and not previously included in a Payment Request or Milestone Payment Request; and

(h) the net amount owing to Developer by the Enterprises or by Developer to the Enterprises in respect of the relevant Payment Month.

2.4 Each Payment Request shall be accompanied by:

(a) work papers clearly setting out the derivation of all amounts set out in the Payment Request to the extent not detailed in the Monthly Deductions Report submitted at the same time as such Payment Request; and

(b) lien waivers duly executed by:

(i) the Developer; and

(ii) (A) all Subcontractors that performed Work during the relevant Payment Month and (B) if the Enterprises in their discretion elected to pay the amount of the Payment Request submitted in respect of any previous Payment Month notwithstanding the failure by Developer to have delivered a lien waiver that complies with the requirements of this Section 2.4(b) from any Subcontractor, any such Subcontractor,

which waivers, in the case of (i) and (ii), shall be substantially in the form set out in, respectively, Appendix A and Appendix B to this Schedule 4 and, in any event, in form and substance acceptable to the Enterprises in their discretion.

2.5 The Enterprises shall notify Developer in writing (with reasons and any supporting documentation available to the Enterprises) within ten Working Days of receipt of any Monthly Deductions Report or Payment Request if there is any part of such report or Payment Request which the Enterprises dispute, provided that a failure by the Enterprises to notify Developer of a Dispute within such period shall not constitute a waiver of their rights to do so at a later date.

2.6 The Enterprises shall pay Developer within 45 Calendar Days of the receipt of a Payment Request which is accurate and complete to the reasonable satisfaction of the Enterprises.

2.7 If:

(a) the Parties agree or it is determined pursuant to the Dispute Resolution Procedures that any Monthly Deductions Report and/or Payment Request was

incorrect or inaccurate, then Developer shall be required to submit a corrected report and/or Payment Request, as the case may be; or

(b) the inaccuracy was identified or the Dispute resolved after the payment of the amount set out in the Payment Request affected by such inaccuracy, the necessary adjustment(s) shall be reflected, as appropriate, in the next Monthly Deductions Report and/or Payment Request to be submitted to the Enterprises after the Parties reach agreement or the Dispute is resolved.

2.8 In no event shall the Enterprises be obligated to pay interest on any late payments arising due to any such inaccuracies.

2.9 The Enterprises may delay payment of the final Performance Payment to be made under this Agreement prior to the Expiry Date for an additional 30 Calendar Days in order to verify the Monthly Deductions Report and Payment Request applicable to such final payment and to allow time for the receipt and verification by the Procuring Authorities of the report submitted pursuant to Section 3.1 of this Part 2 in respect of the Final Payment Month. The Enterprises shall also be entitled to deduct from the Performance Payment otherwise payable in respect of the Final Payment Month the amount of the Monthly Noncompliance Deduction and Operating Period Closure Deductions that accrue in the Final Payment Month.

3. Monthly Deductions Reports

3.1 Each Payment Request shall be accompanied by a report that complies with the requirements of Section 3.2 of this Part 2. In addition, at a date in the Final Payment Month to be agreed between the Parties, Developer shall submit a report that complies with such requirements, which report shall provide the required information in respect of the Final Payment Month (such that, for the purposes of such report, references to the OP Deduction Month in Section 3.2 of this Part 2 shall be deemed to be references to the Final Payment Month).

3.2 Each Monthly Deductions Report required to be submitted to the Enterprises pursuant to Section 3.1 of this Part 2 shall be in a form agreed by the Parties (acting reasonably) and shall contain the following information in relation to (unless expressly provided otherwise in this Section 3.2) the month that immediately precedes the month in which such Monthly Deductions Report is required to be submitted (in the case of each such Monthly Deductions Report, such preceding month, the "OP Deduction Month"):

(a) details of:

(i) each Noncompliance Event (including the nature of such event, its Noncompliance Start Time and, if such time has occurred at the date of such report, its Noncompliance Rectification Time) that accrued Noncompliance Points in the OP Deduction Month in accordance with Table 6A.2 and Part 4 of Schedule 6 (*Performance Mechanism*); and

(ii) the number of such Noncompliance Points that accrued in respect of each such Noncompliance Event (including details of how such number was calculated),

provided that, for certainty, in relation to any such Noncompliance Event that occurred in (A) a month prior to the OP Deduction Month but which continued to subsist during the OP Deduction Month or (B) the OP Deduction Month but which continued to subsist after the end of the OP Deduction Month, the number of Noncompliance Points reported pursuant to this Section 3.2(a) shall be solely the number that accrued in the OP Deduction Month in accordance with Section 3 of Part 4 of Schedule 6 (*Performance Mechanism*);

(b) the aggregate number of Noncompliance Points that accrued in the OP Deduction Month in respect of all Noncompliance Events in accordance with Table 6A.2 and Part 4 of Schedule 6 (*Performance Mechanism*);

(c) the calculation of the Monthly Noncompliance Deduction for the OP Deduction Month;

(d) the cumulative total of Monthly Noncompliance Deductions for all months up to and including the OP Deduction Month;

(e) details of:

(i) each Non-Permitted Operating Period Closure (including the cause of such event, its start time and, if such time has occurred at the date of such report, its end time) that resulted in the accrual of one or more Operating Period Closure Deductions in the OP Deduction Month in accordance with Section 3 of Part 3 of Schedule 6 (*Performance Mechanism*) and Part 5 of Schedule 6 (*Performance Mechanism*); and

(ii) the amount of such Operating Period Closure Deductions that accrued in respect of each such Operating Period Closure Event in the OP Deduction Month (including details of how such amount was calculated),

provided that, for certainty, in relation to any Non-Permitted Operating Period Closure that commenced (A) in a month prior to the OP Deduction Month but which continued to subsist during the OP Deduction Month or (B) in the OP Deduction Month but which continued to subsist after the end of the OP Deduction Month, the amount of Operating Period Closure Deductions reported pursuant to this Section 3.2(e) shall be solely the number that accrued in the OP Deduction Month in accordance with Section 1.2 of Part 5 of Schedule 6 (*Performance Mechanism*);

(f) the calculation of the Monthly Operating Period Closure Deduction for the OP Deduction Month;

(g) the cumulative total of Monthly Operating Period Closure Deductions for all months up to and including the OP Deduction Month;

(h) the calculation of the Monthly Performance Deduction for the OP Deduction Month, being the aggregate of the amounts referred to in Sections 3.2(c) and (f) of this Part 2;

(i) the cumulative total of Monthly Performance Deductions for all months up to and including the OP Deduction Month, being the aggregate of the amounts referred to in Sections 3.2(d) and (g) of this Part 2;

(j) sufficient information to enable the Enterprises to determine whether any of the Noncompliance Default Events specified in paragraph b. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*), or any of the Increased Oversight Thresholds specified in paragraph b. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*), have occurred, which information shall include

(i) the cumulative number of Noncompliance Points accrued during each of the [12] month period and the [36] month period ending at the end of the OP Deduction Month; and

(ii) the cumulative number of Noncompliance Events which have a Grace Period cured during the applicable Grace Period during the [12] month period and the [36] month period ending at the end of the OP Deduction Month;

(k) sufficient information to enable the Enterprises to determine whether either of the Closure Default Events specified in paragraph b. of the definition thereof in Part A of Annex A (*Definitions and Abbreviations*) has occurred, which information shall include the cumulative amount of Operating Period Closure Deductions accrued during the [12] month period and the [36] month period ending at the end of the OP Deduction Month; and

(l) such other information as may reasonably be requested by the Enterprises.

Part 3: General

1. Payments by the Department

Developer agrees that, to the extent that CDOT makes payment to Developer of any amount payable under this Agreement, such payment shall, to the extent of the amount paid by CDOT, be deemed to have discharged the obligation of HPTE and/or BE, as the case may be, to make the relevant payment under this Agreement.

2. Due Date

Unless expressly provided otherwise, the due date for all payments under this Agreement shall be the date which is 45 Calendar Days (in the case of payments to be made by the Enterprises) and 30 Calendar Days (in the case of payments to be made by Developer) after receipt of written request therefor by the Party from which payment is claimed (together with such supporting documentation as is required under this Agreement or reasonably requested by such Party).

3. Default Interest

In the event that any of the Parties fails to pay any amount under this Agreement on the due date therefor, or any of the Parties makes an over-payment of any amount, the Parties have agreed that interest, calculated at the Default Interest Rate and on the basis of a 360 day year for the actual days elapsed, shall, as applicable, be:

(a) added to any late payment from and excluding the due date to and including the date of payment; or

(b) credited to the Party that made the over-payment from and excluding the date of over-payment to and including the date on which the Party that made the over-payment receives credit therefor.

4. Disputed Amounts

4.1 Notwithstanding any other provision of this Agreement, the Enterprises shall have the right to dispute any amount specified in a Milestone Payment Request, Payment Request or Monthly Deductions Report, in which event the Enterprises shall pay the amount of the Milestone Payment Request or Payment Request in question that is not in dispute and will be entitled to withhold the balance pending resolution of the Dispute.

4.2 Developer shall have the right to dispute any determination by the Enterprises that a Milestone Payment Request, Payment Request or Monthly Deductions Report is incomplete and/or incorrect in a material respect.

4.3 Any amount determined to be due pursuant to the Dispute Resolution Procedures will be paid within 45 Calendar Days (in the case of payments to be made by the Enterprises) and 30 Calendar Days (in the case of payments to be made by Developer) following resolution of the Dispute, together with interest thereon in accordance with Section 3 of

this Part 3, provided that in no event shall the Enterprises be obligated to pay interest on any late payments arising due to any inaccuracy in a Milestone Payment Request, Payment Request or Monthly Deductions Report.

5. Set-off

Notwithstanding any other provision of this Agreement:

(a) the Enterprises may set-off against any amount owing to Developer under this Agreement any amount which is agreed or determined to be due from Developer under this Agreement, including:

(i) any funds that must be withheld pursuant to the requirements of C.R.S. §38-26-107(2);

(ii) any amount that the Enterprises are entitled to deduct from the Performance Payments pursuant to Section 4.2(c) of Schedule 12 (*Handback Requirements*); and

(iii) any amounts permitted to be withheld in accordance with Section 53.7.

(b) Developer may set-off against any amount owing to the Enterprises under this Agreement any amount which is agreed or determined to be due from the Enterprises under this Agreement.

Appendix A
Form of Developer Lien Waiver

[*To be provided in a subsequent Addendum*]

Appendix B
Form of Subcontractor Lien Waiver

[*To be provided in a subsequent Addendum*]

Schedule 5
Milestone Payments

1. The table in this Section 1 sets out the amount (each a "Milestone Payment") payable by the Enterprises in respect of the achievement of each Payment Milestone and Substantial Completion, subject to the provisions of this Schedule 5. For certainty, the description of the Payment Milestones in the table below are for reference only; the full definitions of each Payment Milestone are set out in Part A of Annex A (*Definitions and Abbreviations*) and the conditions to achievement of each Payment Milestone and Substantial Completion are set out in, respectively, Parts [ ] and [ ] of Schedule 3 *(Commencement and Completion Mechanics*).

Milestone Payment Table

Payment Milestone	**Milestone Payment**
Completion of Milestone 1 (Sand Creek Bridge to Chambers Road)	$50,000,000
Completion of Milestone 2 (Dahlia Street to Sand Creek Bridge)	$95,000,000
Completion of Milestone 3 (WB I-70 Brighton Boulevard to Dahlia Street)	$52,000,000
Completion of Milestone 4 (EB I-70 Brighton Boulevard to Dahlia Street)	$52,000,000
Substantial Completion	$70,000,000
TOTAL	**$319,000,000**

2. Each Milestone Payment shall be payable no later than the date which is 45 Calendar Days after receipt by the Enterprises of a payment request (a "Milestone Payment Request") from Developer for such Milestone Payment that complies with the requirements of Section 4 of this Schedule 5 (such date, the "Milestone Payment Request Due Date" in respect of such Milestone Payment Request), provided that:

   (a) Developer shall only be entitled to deliver a Milestone Payment Request for a Milestone Payment if, on the Milestone Payment Request Due Date in respect of such Milestone Payment Request (the "Relevant Milestone Payment Request Due Date"), the aggregate amount of:

      (i) such Milestone Payment Request;

      (ii) any Milestone Payment Request(s) delivered simultaneously with such Milestone Payment Request; and

      (iii) all previous Milestone Payment Requests delivered pursuant to this Section 2, will be less than or equal to the amount specified in the "Cumulative Available Funds" column in the table in this Section 2(a) in respect of the period during which the Relevant Milestone Payment Request Due Date occurs;

Cumulative Available Funds Table

Period	Cumulative Available Funds
July 1, 2017 – June 30, 2018	$50,000,000
July 1, 2018 – June 30, 2019	$145,000,000
July 1, 2019 – June 30, 2020	$197,000,000
July 1, 2020 and after	$319,000,000

(b) without prejudice to the requirements of Section 4 of this Schedule 5 (including the requirement that any Milestone Payment Request must be accompanied by the relevant Milestone Completion Certificate or the Substantial Completion Certificate, as the case may be), in order to comply with Section 2(a) of this Schedule 5, Developer shall be entitled to deliver multiple Milestone Payment Requests for payment of less than the full amount of any single Milestone Payment; and

(c) each Milestone Payment Request shall be in respect of a single Milestone Payment (or a portion thereof).

3. Subject to set-off in accordance with Section 5.1 of Part 3 of Schedule 4 (*Payments*):

(a) each Milestone Payment (other than the Substantial Completion Milestone Payment), or portion thereof, shall be paid without deduction; and

(b) the Substantial Completion Milestone Payment shall have deducted from it the Substantial Completion Deduction Amount (the net amount following such deduction, the "Substantial Completion Payment").

4. A Milestone Payment Request delivered:

(a) for a Milestone Payment in respect of the completion of a Payment Milestone shall be accompanied by a copy of the Milestone Completion Certificate in respect of the relevant Payment Milestone;

(b) for the Substantial Completion Payment shall be accompanied by:

(i) a copy of the Substantial Completion Certificate; and

(ii) a report in the form of a Monthly Deductions Report required to be submitted to the Enterprises pursuant to Section 2.1 of Part 1 of Schedule 4 (*Payments*), which shall contain the information specified in Section 2.2 of Part 1 of Schedule 4 (*Payments*) in relation to the period commencing on the day after the end of the CP Deduction Month that was the subject of the most recent Monthly Deductions Report submitted by Developer pursuant to Section 2.1 of Part 1 of Schedule 4 (*Payments*) up to and including the Substantial Completion Date (where, for the purposes of the report submitted pursuant to this Section 4(b)(ii), (A) references to the CP Deduction Month in Section 2.2 of Part 2 of Schedule 4 (*Payments*)

shall be deemed to be references to the period referred to in this Section 4(b)(ii) and

(B) Sections 2.3 and 2.4 of Part 1 of Schedule 4 (*Payments*) shall apply equally to the report submitted pursuant to this Section 4(b)(ii)); and

(c) for any Milestone Payment shall be accompanied by lien waivers duly executed by:

(i) the Developer; and

(ii) (A) all Subcontractors that performed Work since the date of the previous Milestone Payment Request or, in the case of the first Milestone Payment Request, since the Agreement Date (for certainty, including any Subcontractor that performed any Work since the applicable date and not only Subcontractors that performed Work in relation to the Payment Milestone that is the subject-matter of the relevant Milestone Payment Request) and (B) if the Enterprises in their discretion elected to pay the amount of any previous Milestone Payment Request notwithstanding the failure by Developer to have delivered a lien waiver that complies with the requirements of this Section 3(c) from any Subcontractor, any such Subcontractor,

which waivers, in the case of (i) and (ii), shall be substantially in the form set out in, respectively, Appendix A and Appendix B to this Schedule 5 and, in any event, in form and substance acceptable to the Enterprises in their discretion.

5. No later than ten Calendar Days before the Substantial Completion Date, the Enterprises shall publish notice of the anticipated Substantial Completion Date consistent with the requirements of C.R.S. § 38-26-107 such that any applicable Subcontractor who has not yet been paid may file with the Enterprises a verified statement of the amount due and unpaid on account of such Subcontractor's claim.

Appendix A
Form of Developer Lien Waiver

[*To be provided in a subsequent Addendum*]

Appendix B
Form of Subcontractor Lien Waiver

[*To be provided in a subsequent Addendum*]

Schedule 6
Performance Mechanism

Part 1: Construction Period

1. Substantial Completion Deduction Amount

The Substantial Completion Deduction Amount ("SCDA") shall be calculated in accordance with the following formula:

$$SCDA = MND_{sc} + MCCD_{sc}$$

Where:

(a) MND_{sc} = an amount equal to the aggregate of all Monthly Noncompliance Deductions calculated in accordance with Section 2 of this Part 1 that accrued during:

(i) each month (m) that commences during the period from and excluding the Financial Close Date (or, if earlier, the date of issuance of NTP1) to and including the Substantial Completion Date; and

(ii) the month (m) in which the Financial Close Date occurs (or, if earlier, in which the date of issuance of NTP1 occurs),

(each month (m) falling within (i) or (ii), a "CP Deduction Month"); and

(b) $MCCD_{sc}$ = an amount equal to the aggregate of all Monthly Construction Closure Deductions calculated in accordance with Section 3 of this Part 1 that accrued during each CP Deduction Month.

2. Monthly Noncompliance Deduction prior to Substantial Completion

The Monthly Noncompliance Deduction ("MND") for any CP Deduction Month (m) shall be calculated in accordance with the following formula:

$$MND_m = NCPV \times NCP_m$$

Where:

(a) NCPV = $5,000, being the unit value of each Noncompliance Point; and

(b) NCPm = the number of Noncompliance Points that accrued during CP Deduction Month (m) in accordance with Table 6A.1 and Part 4 of this Schedule 6.

3. Monthly Construction Closure Deduction

3.1 The Monthly Construction Closure Deduction ("MCCD") for any CP Deduction Month (m) shall be calculated in accordance with the following formula:

$$MCCD_m = \sum_{p=1}^{n} CCD_p$$

Where

(a) p = a Closure Deduction Period that commenced during CP Deduction Month (m);

(b) n = the total number of Closure Deduction Periods that commenced during CP Deduction Month (m); and

(c) CCD_p = the Construction Closure Deduction in respect of each Closure Deduction Period (p).

3.2 For purposes of calculating the Monthly Construction Closure Deduction for any CP Deduction Month (m) pursuant to Section 3.1 of this Part 1.

(a) each Non-Permitted Construction Closure shall be deemed to:

(i) start when the relevant Closure actually starts; and

(ii) end when the relevant Closure actually ends;

(b) a Construction Closure Deduction shall accrue in the CP Deduction Month in which each individual full or partial Closure Deduction Period commences;

(c) a Closure that affects more than one travel lane shall, to the extent that such Closure otherwise constitutes a Non-Permitted Construction Closure within the definition thereof, be treated as a separate Non-Permitted Construction Closure of each affected travel lane; and

(d) depending upon the duration of any Non-Permitted Construction Closure, such Non-Permitted Construction Closure may result in one or more Construction Closure Deductions, which shall accrue in respect of each full or partial Closure Deduction Period that commences during the subsistence of such Non-Permitted Construction Closure.

Part 2: Performance Payments

1. Monthly Performance Payments

The Performance Payment ("PP") payable in respect of any Payment Month (m) shall be calculated in accordance with the following formula:

$PP_m = MaxPP_m – MPD_{m-1}$

Where:

(a) PP_m = 0, if $MPD_{m-1} \geq MaxPP_m$;

(b) $MaxPP_m$ = the Maximum Performance Payment in respect of Payment Month (m), which shall be calculated in accordance with the following formula:

$$MCCD_m = \left(\frac{d_m}{d_y}\right) \times MaxPP_y$$

Where:

(i) d_m = the number of Calendar Days in Payment Month (m) from and including the first day of Payment Month (m) (or, in the case of the First Payment Month, from and excluding the Substantial Completion Date) to and including the final day of Payment Month (m) (or to and excluding the Termination Date, if earlier);

(ii) d_y = the number of Calendar Days in Contract Year (y); and

(iii) $MaxPP_y$ = the amount of the Maximum Performance Payment calculated in accordance with Section 1 of this Part 2 in respect of Contract Year (y); and

(c) MPD_{m-1} = the Monthly Performance Deduction for month (m-1) (for clarity, month (m-1) in respect of Payment Month (m) is defined as the OP Deduction Month in respect of Payment Month (m)) calculated in accordance with Section 1 of Part 3 of this Schedule 6, provided that:

(i) for certainty, MPD_{m-1} = 0 where Payment Month (m) is the First Payment Month; and

(ii) where Payment Month (m) is the Final Payment Month, MPD_{m-1} shall equal the aggregate of the Monthly Performance Deduction for each of (A) the month immediately preceding the Final Payment Month and (B) the Final Payment Month (provided that, for purposes of calculating the Monthly Performance Deduction for the Final Payment Month, references in Part 3 of this Schedule 6 to OP Deduction Month (m) shall be deemed to be references to the Final Payment Month).

2. **Maximum Performance Payment in each Payment Year**

The Maximum Performance Payment ("MaxPP") in respect of any Contract Year (y) shall be calculated in accordance with the following formula:

$$\text{MaxPP}_y = (\text{Base}_{\text{CPP}} \times (1.02)^{\text{n}}) + (\text{Base}_{\text{OMRP}} \times \left(\frac{\text{CPI}_{\text{y}}}{\text{CPI}_{2017}}\right))$$

Where:

(a) Base_{CPP} = the Base Capital Performance Payment in July 1, 2017 Dollars set out in the table in Section 1(f) of this Part 2;

(b) $\text{Base}_{\text{OMRP}}$ = the Base OMR Payment in July 1, 2017 Dollars set out in the table in Section 1(f) of this Part 2;

(c) CPI_{y} = CPI as of July 1 of Contract Year (y);

(d) CPI_{2017} = CPI as of July 1, 2017;

(e) n = the number of Contract Years from and including the Contract Year commencing on July 1, 2017 to and excluding Contract Year (y); and

(f)

	$[1]
Base Capital Performance Payment (in nominal dollars as of July 1, 2017)	
Base OMR Payment (in nominal dollars as of July 1, 2017)	

[1] Amounts in table to be inserted as specified in Preferred Proposer's Proposal.

Part 3: Performance Payment Deductions

1. Payment Deductions after Substantial Completion

The Monthly Performance Deduction ("MPD") for any OP Deduction Month (m) shall be calculated in accordance with the following formula:

$$\mathrm{MPD_m} = \mathrm{MND_m} + \mathrm{MOPCD_m}$$

Where:

(a) $\mathrm{MND_m}$ = the Monthly Noncompliance Deduction for OP Deduction Month (m) calculated in accordance with Section 2 of this Part 3; and

(b) $\mathrm{MOPCD_m}$ = the Monthly Operating Period Closure Deduction for OP Deduction Month (m) calculated in accordance with Section 3 of this Part 3,

provided that the Monthly Performance Deduction for OP Deduction Month (m) shall not exceed the Maximum Performance Payment in respect of Payment Month (m) calculated in accordance with Section 1(b) of Part 2 of this Schedule 6.

2. Monthly Noncompliance Deduction after Substantial Completion

The Monthly Noncompliance Deduction ("MND") for any OP Deduction Month (m) shall be calculated in accordance with the following formula:

$$\mathrm{MND_m} = \mathrm{NCPV} \times \mathrm{NCP_m}$$

Where:

(a) NCPV = $5,000 (Indexed), being the unit value for each Noncompliance Point; and

(b) $\mathrm{NCP_m}$ = the number of Noncompliance Points that accrued during OP Deduction Month (m) in accordance with Table 6A.2 (or, in accordance with Section 5(a) of Part 4 of this Schedule 6, Table 6A.1) and Part 4 of this Schedule 6.

3. Monthly Operating Period Closure Deduction

3.1 The Monthly Operating Period Closure Deduction ("MOPCD") for any OP Deduction Month (m) shall be calculated in accordance with the following formula:

$$\mathrm{MOPCD_m} = \sum_{\mathrm{p=1}}^{\mathrm{n}} \mathrm{OPCD_p}$$

Where:

(a) p = a full or partial Closure Deduction Period that commenced during OP Deduction Month (m);

(b) n = the total number of full or partial Closure Deduction Periods that commenced during OP Deduction Month (m); and

(c) $OPCD_p$ = the Operating Period Closure Deduction in respect of each full or partial Closure Deduction Period (p).

3.2 The Operating Period Closure Deductions Table is set out below.

Type of Closure	Number of Lanes Subject to the Closure	Operating Period Closure Deduction (each such amount to be indexed) in respect of each full or partial Closure Deduction Period that commences other than on a Weekend or a Holiday
Closure of a General Purpose Lane in one direction in any O&M Segment	One Lane Closed	$10,000
	Two Lanes Closed	$20,000
	Three Lanes Closed	$30,000
Closure of a Tolled Express Lane in one direction in any O&M Segment	One Lane Closed	$25,000
Closure of a Ramp in any O&M Segment	One Lane Closed	$7,500
	Two Lanes Closed	$15,000
Closure of a Cross Street in one direction in any O&M Segment	One Lane Closed	$5,000
	Two Lanes Closed	$10,000
	Three Lanes Closed	$15,000

3.3 At their sole discretion, the Enterprises shall be entitled, no more frequently than once every Contract Year during the Operating Period, to amend (by giving at least 30 Calendar Days' advance notice to Developer of the effective date of such amendment) the Operating Period Closure Deductions Table by either:

(a) amending the amount of any Operating Period Closure Deduction set out in the Operating Period Closure Deductions Table; and/or

(b) introducing different amounts of Operating Period Closure Deduction in respect of an individual type of Closure specified in the O&M Deductions Table for different O&M Segments,

provided that, following any such amendment, no Operating Period Closure Deduction shall exceed the highest Operating Period Closure Deduction set out in the Operating Period Closure Deductions Table prior to such amendment.

3.4 Without prejudice to the right of the Enterprises in their sole discretion to make any amendments to the Operating Period Closure Deductions Table in accordance with Section 3.3 of this Part 3, they shall consult with Developer prior to giving a notice to Developer pursuant to such Section.

Part 4: Noncompliance Points

Each Noncompliance Event shall accrue Noncompliance Points as follows.

1. Subject to Section 4 of this Part 4, for any Noncompliance Event that has a Cure Period, such Noncompliance Event shall accrue the number of Noncompliance Points set out against such Noncompliance Event in Table 6A.1 or Table 6A.2, as applicable, for each full or partial Noncompliance Cure Period that commences at any time from and including:

   (a) if such Noncompliance Event does not have a Grace Period, the Noncompliance Start Time; and

   (b) if such Noncompliance Event has a Grace Period, the expiry of the Grace Period,

   in each case, until the Noncompliance Rectification Time.

2. For any Noncompliance Event that has no Cure Period, such Noncompliance Event shall accrue the number of Noncompliance Points set out against such Noncompliance Event in Table 6A.1 or Table 6A.2, as applicable, but shall not accrue any further Noncompliance Points during the period that the failure giving rise to the original Noncompliance Event continues to subsist. Notwithstanding the foregoing, any subsequent recurrence of the same Noncompliance Event shall be treated as a separate Noncompliance Event and shall accrue Noncompliance Points in accordance with this Part 4.

3. Noncompliance Points in respect of a Noncompliance Event:

   (a) that has a Cure Period shall accrue in the month in which each individual Noncompliance Cure Period commences; and

   (b) that has no Cure Period shall accrue in the month in which the Noncompliance Start Time occurs.

4. Subject to Section 1.2(b)(i) of Part 6 of this Schedule 6, if a Noncompliance Event has a Grace Period and the Noncompliance Rectification Time for such Noncompliance Event occurs prior to the expiry of such Grace Period, such Noncompliance Event shall not accrue any Noncompliance Points.

5. If the Noncompliance Start Time of any Noncompliance Event which has a Cure Period occurs prior to or on the Substantial Completion Date and such Noncompliance Event continues to subsist after the Substantial Completion Date, then:

   (a) if such Noncompliance Event is set out only in Table 6A.1, such Noncompliance Event shall accrue the number of Noncompliance Points set out against such Noncompliance Event in Table 6A.1 for each full or partial Noncompliance Cure Period (to be determined by reference to the Cure Period of such Noncompliance Event set out in Table 6A.1) that commences prior to, on or after the Substantial Completion Date; and

   (b) if such Noncompliance Event is set out in both Table 6A.1 and Table 6A.2, such Noncompliance Event shall accrue the number of Noncompliance Points set out against such Noncompliance Event:

      (i) in Table 6A.1 for each full or partial Noncompliance Cure Period (to be determined by reference to the Cure Period of such Noncompliance Event set out in Table 6A.1) that commences prior to or on the Substantial Completion

Date (for certainty, including where such Noncompliance Cure Period ends after the Substantial Completion Date); and

(ii) in Table 6A.2 for each full or partial Noncompliance Cure Period (to be determined by reference to the Cure Period of such Noncompliance Event set out in Table 6A.2) that commences after the Substantial Completion Date.

6. Nothing in this Agreement shall prevent the accrual of Noncompliance Points in respect of both the occurrence of a Noncompliance Event and the Noncompliance Event caused by the failure to notify the Enterprises of the same Noncompliance Event in accordance with this Agreement.

Part 5: Operating Period Closures

1. Occurrence of Operating Period Closures

1.1 Each Non-Permitted Operating Period Closure shall be deemed to:

(a) start when the relevant Closure actually starts; and

(b) end when the relevant Closure actually ends.

1.2 An Operating Period Closure Deduction shall accrue in the month in which each individual full or partial Closure Deduction Period commences.

1.3 A continuous Closure that affects more than one O&M Segment shall, to the extent that such Closure otherwise constitutes a Non-Permitted Operating Period Closure within the definition thereof, be treated as a separate Non-Permitted Operating Period Closure in each affected O&M Segment.

1.4 Depending upon the duration of any Non-Permitted Operating Period Closure, such Non-Permitted Operating Period Closure may result in one or more Operating Period Closure Deductions, which shall accrue in respect of each full or partial Closure Deduction Period that commences during the subsistence of such Non-Permitted Operating Period Closure.

2. Operating Period Closure Deduction Modifications

2.1 Where a Non-Permitted Operating Period Closure is caused by the Closure of one or more contra-flow lanes, the Operating Period Closure Deduction in respect of each full or partial Closure Deduction Period that commences during the subsistence of such Non-Permitted Operating Period Closure shall be the Operating Period Closure Deduction that would otherwise have accrued multiplied by 110%.

2.2 Where a Non-Permitted Operating Period Closure is caused by the Closure of part of a ramp such that the ramp remains available for use by traffic but is partially restricted, the Operating Period Closure Deduction in respect of each full or partial Closure Deduction Period that commences during the subsistence of such Non-Permitted Operating Period Closure shall be the Operating Period Closure Deduction that would otherwise have accrued multiplied by 50%.

2.3 Where a Non-Permitted Operating Period Closure is caused by the Closure of a shoulder only, and continued flow of traffic on the adjacent travel lane may be safely permitted, the Operating Period Closure Deduction in respect of each full or partial Closure Deduction Period that commences during the subsistence of such Non-Permitted Operating Period Closure shall be the Operating Period Closure Deduction that would have accrued had the adjacent travel lane been subject to such Closure multiplied by 50%.

2.4 Where a Non-Permitted Operating Period Closure is caused by the Closure of a travel lane but the adjacent shoulder is temporarily utilized as a replacement travel lane, the Operating Period Closure Deduction in respect of each full or partial Closure Deduction Period that commences during the subsistence of such Non-Permitted Operating Period Closure shall be the Operating Period Closure Deduction that would otherwise have accrued multiplied by 50%.

2.5 Where a Non-Permitted Operating Period Closure is caused by the Closure of a single General Purpose Lane or Tolled Express Lane in one direction of travel and the adjacent shoulder is consequently closed or inaccessible to traffic, the Closure of the shoulder shall be deemed not to constitute a Non-Permitted Operating Period Closure.

2.6 Where a Non-Permitted Operating Period Closure is caused by the Closure of any sidewalk, the Operating Period Closure Deduction in respect of each full or partial Closure Deduction Period that commences during the subsistence of such Non-Permitted Operating Period Closure shall be the Operating Period Closure Deduction that would have accrued had one lane of the adjacent travel lane been subject to such Closure multiplied by 10%, provided that, for certainty:

(a) the Closure of each sidewalk on either side of the relevant travel lane shall constitute a separate Non-Permitted Operating Period Closure; and

(b) each Operating Period Closure Deduction that accrues in respect of the Non-Permitted Operating Period Closure of a sidewalk shall be in addition to any Operating Period Closure Deductions that accrue in respect of a Non-Permitted Operating Period Closure caused by the Closure of the adjacent travel lane.

2.7 Where a Non-Permitted Operating Period Closure is caused by the Closure of a cross street, each such Non-Permitted Operating Period Closure shall result in the accrual of Operating Period Closure Deductions in addition to any Operating Period Closure Deductions that accrue in respect of any Non-Permitted Operating Period Closure simultaneously caused by the Closure of any General Purpose Lane, Tolled Express Lane, ramp and/or shoulder.

Part 6: Reporting Requirements

1. Notification

1.1 Notification Initiated by Developer

(a) Developer shall notify the Enterprises in writing of the occurrence of any Noncompliance Event or the commencement of any Non-Permitted Closure or Excused Closure as soon as reasonably practicable, and in any event within twenty-four (24) hours, after Developer first becomes aware that the Noncompliance Event has occurred or the Non-Permitted Closure or Excused Closure has commenced. Such notice shall:

(i) in the case of a Noncompliance Event:

(A) provide reasonable detail of the circumstances of such Noncompliance Event and its Noncompliance Start Time;

(B) identify the number of Noncompliance Points and the Grace Period (if any) and the Cure Period (if any) for such Noncompliance Event, all as specified in Table 6A.1 or Table 6A.2, as applicable; and

(C) if such Noncompliance Event has been cured by the time notice is given pursuant to this Section 1.1(a), identify its Noncompliance Rectification Time (if such Noncompliance Event has a Cure Period) or the date and time that such Noncompliance Event was fully cured (if such Noncompliance Event does not have a Cure Period); or

(ii) in the case of a Non-Permitted Closure or Excused Closure:

(A) provide reasonable details of the circumstances of such Non-Permitted Closure or Excused Closure, its commencement time and (if it has ended by the time notice is given pursuant to this Section 1.1(a)), its end time;

(B) in the case of an Excused Closure:

(I) explain the basis (using the categories specified in paragraphs a. to d. of the definition of Excused Closure in Part A of Annex A (*Definitions and Abbreviations*)) on which Developer considers that the relevant Closure is an Excused Closure; and

(II) confirm that the relevant Closure did not arise as a result of any of the circumstances specified in paragraphs A.I or A.II of the definition of Excused Closure in Part A of Annex A (*Definitions and Abbreviations*); and

(C) explain the steps being taken by Developer to:

(I) mitigate the impact thereof;

(II) reopen the affected part(s) of the Project as quickly as possible to traffic; and

(III) if such Closure arose as the direct result of an Emergency, respond to the Emergency in accordance with the requirements of this Agreement.

(b) Within ten Calendar Days after receiving a notice pursuant to Section 1.1(a) of this Part 6, the Enterprises shall deliver to Developer a written notice either confirming their agreement to, or disputing (with reasons), the information contained in Developer's notice. Due to extenuating circumstances, the Enterprises may, at their discretion, provide an extension to any Grace Period applicable to a Noncompliance Event so notified and will document such extension in the notice delivered by them pursuant to this Section 1.1(b).

(c) Developer shall notify the Enterprises in writing as soon as reasonably practicable, and in any event within 24 hours, after the occurrence of the Noncompliance Rectification Time in respect of any Noncompliance Event which has a Cure Period, the date and time that any Noncompliance Event which does not have a Cure Period has been fully cured or the end time of any Non-Permitted Closure or Excused Closure, including in such notice:

(i) in the case of a Noncompliance Event:

(A) the Noncompliance Rectification Time of such Noncompliance Event or, as the case may be, the date and time that such Noncompliance Event was fully cured;

(B) a detailed description of the manner in which such Noncompliance Event was cured; and

(C) a calculation of the total Noncompliance Points that accrued in respect of such Noncompliance Event; or

(ii) in the case of a Non-Permitted Closure or Excused Closure:

(A) the end time of such Non-Permitted Closure or Excused Closure; and

(B) in the case of a Non-Permitted Closure, a calculation of the total Construction Closure Deductions or Operating Period Closure Deductions, as the case may be, that accrued in respect of such Non-Permitted Closure.

(d) Within ten Calendar Days after receiving a notice pursuant to Section 1.1(c) of this Part 6, the Enterprises shall deliver to the Developer a written notice either confirming their agreement to, or disputing (with reasons), the information contained in Developer's notice.

(e) Developer shall be entitled to satisfy its notification obligations under this Section 1.1 by ensuring that the Noncompliance and Closure Database issues email or other alerts to the Enterprises, provided that such alerts:

(i) are received by the Enterprises within the time periods required by Section 1.1(a) or (c) of this Part 6, as applicable; and

(ii) either:

(A) contain the information required by Section 1.1(a) or (c) of this Part 6, as applicable; or

(B) provide a direct link to such information.

1.2 Notification Initiated by the Enterprises

(a) If the Enterprises believe that any Noncompliance Event or Non-Permitted Closure has commenced in respect of which the Enterprises have not received notification from Developer in accordance with Section 1.11.1(a) of this Part 6, the Enterprises may deliver to Developer a notice containing such of the information that is required to be included in the notice that Developer should have delivered pursuant to Section 1.11.1(a) of this Part 6 in respect of such Noncompliance Event or Non-Permitted Closure that is available to the Enterprises.

(b) In the event that the Enterprises deliver a notice pursuant to Section 1.2(a) of this Part 6.

(i) if a Noncompliance Event that has a Grace Period is the subject of such notice, such Noncompliance Event shall be deemed not to have a Grace Period even if a Grace Period is specified for such Noncompliance Event in Table 6A.1 or Table 6A.2, as applicable; and

(ii) the failure by Developer to issue a notice in respect of the relevant Noncompliance Event or Non-Permitted Closure shall itself constitute a Noncompliance Event in accordance with item 1.14 in Table 6A.1 or item 2.16 in Table 6A.2, as applicable.

2. Noncompliance and Closure Database

2.1 Without prejudice to Developer's obligations under Section 1 of this Part 6, Developer shall establish and maintain an electronic database that records on a real-time basis, and retains, information in relation to each and every Noncompliance Event, Non-Permitted Closure and Excused Closure that occurs or commences, as the case may be. The following data shall be recorded in such database:

(a) in respect of each Noncompliance Event (whether notified by Developer to the Enterprises pursuant to Section 1.1(a) of this Part 6 or by the Enterprises to Developer pursuant to Section 1.21.2(a) of this Part 6):

(i) a description of such Noncompliance Event in reasonable detail, including the circumstances giving rise to such Noncompliance Event, its Noncompliance Start Time, any applicable Cure Period or Grace Period and the number of Noncompliance Points set out for such Noncompliance Event in Table 6A.1 or Table 6A.2, as applicable;

(ii) the location of such Noncompliance Event within the Project (if applicable);

(iii) for any Noncompliance Event that is not yet cured:

(A) the calculation of the Noncompliance Points that have accrued in respect of such Noncompliance Event up to that time; and

(B) the steps being taken to cure it; and

(iv) for any Noncompliance Event that Developer considers to be cured:

(A) the Noncompliance Rectification Time of such Noncompliance Event (if such Noncompliance Event has a Cure Period) or the date and time that such Noncompliance Event was fully cured (if such Noncompliance Event does not have a Cure Period) and, in either case, the calculation

of the total Noncompliance Points that accrued in respect of such Noncompliance Event; and

(B) the nature of the cure in reasonable detail and the measures that have been, and will be, taken to prevent the reoccurrence of such Noncompliance Event;

(b) in respect of each Non-Permitted Closure (whether notified by Developer to the Enterprises pursuant to Section 1.1(a) of this Part 6 or by the Enterprises to Developer pursuant to Section 1.21.2(a) of this Part 6) and each Excused Closure:

(i) a description of such Non-Permitted Closure or Excused Closure in reasonable detail, including the location thereof within the Project, the circumstances giving rise to such Non-Permitted Closure or Excused Closure and its commencement time;

(ii) for any Non-Permitted Closure or Excused Closure that is continuing:

(A) in the case of a Non-Permitted Closure, the calculation of the Construction Closure Deductions or Operating Period Closure Deductions, as the case may be, that have accrued in respect of such Non-Permitted Closure up to that time; and

(B) a description of the steps being taken by Developer to:

(I) mitigate the impact thereof;

(II) reopen the affected part(s) of the Project as quickly as possible to traffic; and

(III) if such Closure arose as the direct result of an Emergency, respond to the Emergency in accordance with the requirements of this Agreement; and

(iii) for any Non-Permitted Closure or Excused Closure that has ended:

(A) the end time of such Non-Permitted Closure or Excused Closure;

(B) in the case of a Non-Permitted Closure, the calculation of the total Construction Closure Deductions or Operating Period Closure Deductions, as the case may be, that accrued in respect of such Non-Permitted Closure; and

(C) all of the steps taken by Developer as referred to in Section 2(b)(ii) of this Part 6 during the subsistence of such Non-Permitted Closure or Excused Closure and the measures that have been, and will be, taken to prevent the reoccurrence of similar Non-Permitted Closures or Excused Closures.

2.2 The database shall also record on a real-time basis:

(a) the cumulative number of Noncompliance Points that have accrued and cumulative number of relevant Noncompliance Events that have occurred in such a manner as to allow the Parties to establish at any time whether any Noncompliance Default Event or any Increased Oversight Threshold has occurred; and

(b) the cumulative amount of Construction Closure Deductions and Operating Period Closure Deductions that have accrued in such a manner as to allow the Parties to establish at any time whether any Closure Default Event has occurred.

2.3 Developer shall provide to the Enterprises unrestricted electronic access to the Noncompliance and Closure Database at all times and the database shall be designed to enable the Enterprises to:

(a) inspect all entries by Developer;

(b) flag a request for further information from Developer related to any entry;

(c) flag any entry where the Enterprises dispute the entry;

(d) enter information in respect of each Noncompliance Event and Non-Permitted Closure notified to Developer by the Enterprises pursuant to Section 1.2(a) of this Part 6 to the same level of detail as Developer is required to enter in respect of Noncompliance Events and Non-Permitted Closures notified by it to the Enterprises pursuant to Section 1.1(a) of this Part 6;

(e) record for each Noncompliance Event or Non-Permitted Closure the issuance of a notice by the Enterprises pursuant to Section 1.2(a) of this Part 6;

(f) automatically generate a report recording the number and details of:

(i) Noncompliance Events that have been cured and remain uncured; and

(ii) Non-Permitted Closures and Excused Closures that have ended and are continuing,

in either case, including:

(iii) separate counts of:

(A) Noncompliance Events, Non-Permitted Closures and Excused Closures notified by Developer pursuant to Section 1.1(a) of this Part 6; and

(B) Noncompliance Events and Non-Permitted Closures notified by the Enterprises pursuant to Section 1.2(a) of this Part 6; and

(iv) the number of Noncompliance Points, Construction Closure Deductions and Operating Period Closure Deductions:

(A) accrued by Developer; and

(B) subject to dispute by either Party,

in any such case, within any user-defined time period; and

(g) flag the Enterprises' concurrence or otherwise that the Noncompliance Rectification Time has occurred in respect of Noncompliance Event or a Non-Permitted Closure has ended.

APPENDIX A

Noncompliance Points Tables

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.1	Developer's Management Process	Audit of Project Management Plan (PMP)	Carry out and submit to the Department planned and systematic audits of the Project Management Plan at times and in the manner prescribed in the Project Management Plan and in accordance with Schedule 8, Section 2.2.1.	7	N/A	1
1.2	Developer's Management Process	Compliance with PMP	Establish, maintain, update or comply with any provision of the Project Management Plan as described in Schedule 8, Section 2 except as otherwise provided in this Table 6A.1.	7	7	2
1.3	Developer's Management Process	Compliance with QMP	Establish, maintain, update or comply with any provision of the Quality Management Plan as described in Schedule 8, Section 6.	7	7	2
1.4	Developer's Management Process	Compliance with Safety Plan	Formally establish, adhere to or enforce a safety policy, procedure, process, or guideline as required by the Safety Management Plan as described in Schedule 8, Section 7.	2	N/A	4

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.5	Developer's Management Process	Implement and maintain an Environmental Compliance Work Plan (ECWP)	Implement, maintain and update a complete Environmental Compliance Work Plan (ECWP) as described in Schedule 17, Section 1.2.	2	N/A	2
1.6	Developer's Management Process	Comply with Document Control System	Comply with the requirements of the Document Control System (DCS) in accordance with Schedule 8, Section 13.	2	N/A	1
1.7	Developer's Management Process	Submissions to Quality Records Database	Submit records of materials testing and information to the Department's Quality Records Database (in accordance with the requirements of Schedule 8, Section 6.4.3.	7	7	2
1.8	Developer's Management Process	Employment of Key Personnel	Cause the continuous employment in connection with the Work of any of the Key Personnel required to be employed during the Construction Period complying with the qualifications requirements or the time periods specified in Schedule 27.	14	14	5
1.9	Developer's Management Process	Licensing of Key Personnel	Submit documentation demonstrating compliance with license requirements with regard to Key Personnel as described in Schedule 27.	7	7	1

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.10	Developer's Management Process	Public Meetings and Communication	Prepare, maintain and implement the Strategic Communications Plans identified in Schedule 8, Section 2.2 and the requirements of which are further detailed in Schedule 8, Section 2.3 (Construction Work Communications Plan), Schedule 8, Section 2.4 (Maintenance and Operations Communications Plan) and Schedule 8, Section 2.5 (Crisis Communications Plan).	1	N/A	2
1.11	Developer's Management Process	Administrative process for Meetings	Conduct, attend or follow specified process in connection with any meeting during the Construction Period as described in Schedule 8 including providing notification to the Department of the meeting details.	N/A	N/A	1
1.12	Deliverables	General Deliverables	Prepare, implement, maintain, update or submit any plan, report, deliverable or other Deliverable in accordance with the provisions of this Agreement, except as otherwise provided in this Table 6A.1.	14	7	1

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.13	Deliverables	General Deliverables	Incorporate the Department's comments with respect to any Deliverable (excluding any Deliverable submitted specifically "For Information") prior to the next submittal of the Deliverable in accordance with Schedule 9.	14	7	1
1.14	Deliverables	Noncompliance Reporting	Provide accurate, complete and timely reporting of any Noncompliance Event and the Noncompliance Points accrued in respect of such Noncompliance Event, as required by Schedule 6, Part 6, Section 1.1.	N/A	N/A	2
1.15	Deliverables	Federal and State Requirements	Comply in a timely, accurate and complete manner with any of the reporting requirements contained in Schedule 15.	14	7	2
1.16	Deliverables	Submit insurance records	Submit documents verifying insurance coverage and payment of insurance premiums and renewals in accordance with Section 25.	21	N/A	1
1.17	Deliverables	Monthly Deductions Report	Submit a Monthly Deductions Report pursuant to Schedule 4, Part 1, Section 2.1 or Schedule 5, Section 4(b)(ii).	7	N/A	1

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.18	Deliverables	Documentation for DBE plan	Comply with the requirements of Schedule 14, Section 3.1.4.d regarding DBE/WDP Report and tracking.	7	N/A	2
1.19	Deliverables	On the job training	Comply with the requirements of Schedule 14, Section 3.1.4.e regarding OJT and local hiring tracking.	7	N/A	1
1.20	Deliverables	Governmental Approvals and Permits	Deliver to the Department: (a) any documentation required to be submitted pursuant to Section 8.4.3; or (b) copies of new or amended Governmental Approvals or Permits obtained in accordance with Section 8.4.	7	7	1
1.21	Deliverables	Record keeping for Utilities	Make records relating to Utilities available as required by Schedule 10, Section 4.	7	N/A	2

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.22	Deliverables	Submit testing records	Provide to the Department within the specified time periods and conforming to the requirements of Schedule 8, Section 6 the results of any Testing performed by the Developer during the Construction Period of any materials or components of the Work.	2	2	3
1.23	Deliverables	Certification	Submit required valid certificates in relation to the Work in accordance with Schedule 8, Section 6.4.3.	2	N/A	1
1.24	Department Oversight	Inspection and Audit by the Department or Governmental Authorities	Comply with any requirements to provide advance notice, access to Project Records, or otherwise ensure Reasonable Efforts to support the Department or any Governmental Authority with regard to their rights to audit, review, inspection, or testing in accordance with Section 21.	5	N/A	3
1.25	Department Oversight	Provision of access to Project Records	Keep, maintain, permit access or make available to the Department at the specified location, within specified time of request and for the specified retention period, any Project Record as required by Section 19.	5	N/A	1

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.26	Department Oversight	Department Safe Access to Site and other off-Site locations	Provide safe physical access for the Enterprise Representatives, to the Site or where materials are to be inspected, at an off-Site location and to the Developer's project field offices in connection with the Work and all inspections as required by Schedule 8.	2	N/A	4
1.27	Department Oversight	Department Facilities	Comply with any of the requirements of Schedule 8, Section 11 regarding the provision of offices and equipment for the Department.	7	7	1
1.28	Department Oversight	Increased Oversight	Comply with any Approved remedial plan required in accordance with the need for increased oversight by the Department as detailed in Section 21.3.	7	N/A	4
1.29	Notification by Developer	Notification of Hazardous Substances	Notify the Department upon encountering Hazardous Substances in accordance with Schedule 17.	N/A	N/A	4

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.30	Notification by Developer	Notification of Environmental breach	Notify the Department of any breach by the Developer of any Environmental Laws or any of the Environmental Requirements, including, but not limited to, exceedance of permitted thresholds for air quality, water quality, noise, and vibration requirements, as required by applicable Law and all relevant Governmental Approvals.	N/A	N/A	4
1.31	Notification by Developer	Utility Compliance	Promptly notify the Department regarding the compliance of Utilities with their respective URAs during the Construction Period in accordance with Schedule 10, Section 4.2.	N/A	N/A	2
1.32	Notification by Developer	NPDES requirement	Notify to the Department and the applicable Governmental Authority the Developer's failure to comply with a NPDES Permit (including, but not limited to: failure to comply with BMP, incomplete SWPPP, or failure to correctly implement the SWPPP).	2	N/A	4

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.33	Notification by Developer	Railroad Compliance	Promptly notify the Department regarding the compliance of Railroads with their respective RRAs during the Construction Period in accordance with Schedule 10, Section 10.	N/A	N/A	2
1.34	Project Delivery	Maintenance of Traffic Requirements	Perform Work in compliance with any of Developer's obligations (other than those obligations in respect of lane Closures or Closures which are subject to Construction Closure Deductions in accordance with Schedule 6) in respect of maintenance of traffic as set out in Schedule 10, Section 2, and including all maintenance of traffic requirements associated with the Swansea School.	N/A	N/A	4
1.35	Project Delivery	Schedule Deliverable Compliance	Comply with any scheduled Deliverable requirement set out in Schedule 8.	7	7	2
1.36	Project Delivery	Maintain Utility Service	Maintain a Utility fully operational except as specifically permitted by the Utility Owner and by any affected property in accordance with Schedule 10, Section 4.2.9.	2	N/A	4

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.37	Project Delivery	NPDES requirements	Comply with a NPDES Permit (including, but not limited to: failure to comply with BMP, incomplete SWPPP, or failure to correctly implement the SWPPP).	2	N/A	5
1.38	Project Delivery	Right-of-Way Requirements	Perform Work in compliance with any of Developer's obligations in respect of Right-of-Way as set out in Schedule 18.	N/A	N/A	4
1.39	Project Delivery	Courtesy Patrol Services	Comply with any provision of Schedule 11, Appendix B (Courtesy Patrol Requirements), excluding the General Requirements in relation to the Courtesy Patrol Services in the Performance and Measurement Tables.	7	N/A	1
1.40	Inspections, Defects and Standards	Timely Remedy of Category 1 Defect	Remedy a Category 1 Defect (Immediate Action) within the Defect Remedy Period.	Defect Remedy Period	N/A	4
1.41	Inspections, Defects and Standards	Timely Remedy of Category 1 Defect	Remedy a Category 1 Defect (Permanent Remedy) within the Defect Remedy Period.	Defect Remedy Period	N/A	2
1.42	Inspections, Defects and Standards	Timely Remedy of Category 2 Defect	Make permanent remedy of a Category 2 Defect (Permanent Repair) within the Defect Remedy Period.	Defect Remedy Period	N/A	1

Table 6A.1 - Construction Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
1.43	Inspections, Defects and Standards	Prevent occurrence of Defect	Prevent a Category 2 Defect from deteriorating into a Category 1 Defect.	N/A	N/A	1
1.44	Commencement Conditions	Commencement of Operations During Construction	Obtain the issuance of NTP3 by July 1, 2017.	5	N/A	10

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.1	Developer's Management Process	Audit of Project Management Plan (PMP)	Carry out and submit to the Department planned and systematic audits of the Project Management Plan at times and in the manner prescribed in the Project Management Plan and in accordance with Schedule 8, Section 2.2.1.	7	N/A	1
2.2	Developer's Management Process	Compliance with PMP	Establish, maintain, update or comply with any provision of the Project Management Plan (PMP) as described in Schedule 8, Section 2.	7	7	2
2.3	Developer's Management Process	Compliance with Safety Plan	Formally establish, adhere to or enforce a safety policy, procedure, process, or guideline as required by the Safety Plan as described in Schedule 8, Section 7.	2	N/A	4
2.4	Developer's Management Process	Implement and maintain an Environmental Compliance Work Plan (ECWP)	Implement, maintain and update a complete Environmental Compliance Work Plan (ECWP) as described in Schedule 17, Section 1.2.	2	N/A	2
2.5	Developer's Management Process	Comply with Document Control System	Comply with the requirements of the Document Control System (DCS) in accordance with Schedule 8, Section 13.	2	N/A	2

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.6	Developer's Management Process	Maintenance Management System (MMIS)	Follow any of the requirements of the Maintenance Management Information System (MMIS) in accordance with Schedule 11, Section 7.	7	7	2
2.7	Developer's Management Process	Administrative process for Meetings	Conduct, attend or follow specified process in connection with any meeting during the Operating Period as described in Schedule 11 including notification of Department.	N/A	N/A	1
2.8	Developer's Management Process	Updates to the Performance Requirements	Provide timely, accurate and complete updates to the Performance Requirements in accordance with Schedule 11, Section 4.2.5.	14	7	1
2.9	Developer's Management Process	Employment of Key Personnel	Cause the continuous employment in connection with the O&M Work of any of the Key Personnel required to be employed during the O&M Period complying with the qualifications requirements or the time periods specified in Schedule 27.	14	14	1
2.10	Developer's Management Process	Licensing of Key Personnel	Submit documentation demonstrating compliance with license requirements with regard to Key Personnel in accordance with Schedule 27.	7	7	1

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.11	Developer's Management Process	Public Meetings and Communication	Prepare, maintain and implement the applicable Strategic Communications Plans identified in Schedule 8, Section 2.2 and the requirements of which are further detailed in Schedule 8, Section 2.4 (Maintenance and Operations Communications Plan) and Schedule 8, Section 2.5 (Crisis Communications Plan).	1	N/A	2
2.12	Deliverables	General Deliverables	Prepare, implement, maintain, update or submit any plan, report, deliverable or other Deliverable in accordance with this Agreement, except as otherwise provided in this Table 6A.2.	14	7	1
2.13	Deliverables	General Deliverables	Incorporate the Department's comments with respect to any Deliverable (excluding any Deliverable submitted specifically "For Information") prior to the next submittal of the Deliverable in accordance with Section 9.	14	7	1
2.14	Deliverables	Maintenance Reporting	Provide a complete, accurate and timely Monthly O&M Report as required by Schedule 11, Section 15.1.	7	N/A	1

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.15	Deliverables	Maintenance Reporting	Provide a complete, accurate and timely Annual O&M Report as required by Schedule 11, Section 15.2.	14	7	1
2.16	Deliverables	Noncompliance Reporting	Provide accurate, complete and timely reporting of any Noncompliance Events and the Noncompliance Points accrued in respect of such Noncompliance Event, as required by Schedule 6, Part 6, Section 1.1.	14	N/A	2
2.17	Deliverables	Renewal Work Schedule	Provide or revise the accurate and complete Renewal Work Schedule as part of the Maintenance Management Plan and Renewal Work Plan and as required by Schedule 11, Section 5.2 and Section 6.1 respectively.	14	N/A	2
2.18	Deliverables	Handback Reserve Account	Provide the report setting forth accurate and complete calculations of the Handback Reserve Amount in accordance with Schedule 12, Section 4.	14	N/A	2
2.19	Deliverables	Federal and State Requirements	Comply in a timely, accurate and complete manner with any of the reporting requirements contained in Schedule 15.	14	7	2

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.20	Deliverables	Governmental Approvals and Permits	Deliver to the Department: (a) any documentation required to be submitted pursuant to Section 8.4.3; or (b) copies of new or amended Governmental Approvals or Permits obtained in accordance with Section 8.4.	7	7	1
2.21	Deliverables	Submit insurance records	Submit documents verifying insurance coverage and payment of insurance premiums and renewals in accordance with Section 25.	21	N/A	1
2.22	Deliverables	Monthly Report	Submit a Monthly Deductions Report pursuant to Schedule 4, Part 2, Section 3.1.	N/A	N/A	1
2.23	Deliverables	Residual Life Methodology Report	Prepare and submit a timely, accurate and complete Residual Life Methodology Report in accordance with Schedule 12, Section 3.3.	7	N/A	1

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.24	Deliverables	Handback Inspection and Report	Conduct Handback Inspections or prepare and submit a timely and complete Handback Inspection Reports in accordance with Schedule 12, Section 3.	7	N/A	1
2.25	Department Oversight	Inspection and Audit by the Department or Governmental Entities	Comply with any requirements to provide advance notice, access to Project Records, or otherwise ensure Reasonable Efforts to support the Department or any Governmental Authority with regard to their rights to audit, review, inspect, or conduct tests in accordance with Section 21.	5	N/A	1
2.26	Department Oversight	Provision of access to Project Records	Keep, maintain, permit access or make available to the Department at the specified location, within specified time of request and for the specified retention period, any Project Record as required by Section 19.	5	N/A	1

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.27	Department Oversight	Department Safe Access to Site and other off-Site locations	Provide safe physical access for Enterprise Representatives, to the Site or where materials are to be inspected, at an off-Site location and to the Developer's project field offices in connection with the O&M Work After Construction and all inspections as required by Schedule 11 and Schedule 12.	2	N/A	4
2.28	Department Oversight	Increased Oversight	Comply with any Approved remedial plan required in accordance with the need for increased oversight by the Department as detailed in Section 21.3.	7	N/A	4
2.29	Project Delivery	NPDES requirement	Comply with a NPDES Permit (including, but not limited to: failure to comply with BMP, incomplete SWPPP, or failure to correctly implement the SWPPP).	2	N/A	4

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.30	Project Delivery	Courtesy Patrol Services	Comply with any provision of Schedule 11, Appendix B (Courtesy Patrol Requirements), excluding the General Requirements in relation to the Courtesy Patrol Services in the Performance and Measurement Tables.	7	N/A	1
2.31	Project Delivery	Punch List	Prepare, maintain or timely deliver in accordance with Schedule 3, Part 7 a Punch List (or a modification thereto) containing all items of Work to be completed, corrected, adjusted or modified.	7	N/A	4
2.32	Project Delivery	Final Acceptance	Achieve Final Acceptance prior to the Final Acceptance Deadline.	5	N/A	15
2.33	Notification by Developer	NPDES requirement	Notify to the Department and the applicable Governmental Authority the Developer's failure to comply with a NPDES Permit (including, but not limited to: failure to comply with BMP, incomplete SWPPP, or failure to correctly implement the SWPPP).	2	N/A	2

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.34	Notification by Developer	Notification of Regulated Material	Notify the Department upon encountering Hazardous Materials in accordance with Schedule 17, Section 1.24.	N/A	N/A	4
2.35	Notification by Developer	Notification of Environmental Breach	Notify the Department of any breach by the Developer of any Environmental Laws or any of its Environmental Requirements, including, but not limited to exceedance of permitted thresholds for air quality, water quality, noise, and vibration requirements, as required by applicable Law and all relevant Governmental Approvals.	N/A	N/A	4
2.36	Inspections, Defects and Standards	Timely and accurate Inspections	Perform timely and accurate inspections in accordance with Schedule 10 (in respect of Renewal Work), Schedule 11 and Schedule 12 for any of the inspections identified in such Schedules.	7	N/A	1
2.37	Inspections, Defects and Standards	Timely Remedy of Category 1 Defect	Remedy a Category 1 Defect (safety critical) within the Defect Remedy Period.	Defect Remedy Period	N/A	4

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.38	Inspections, Defects and Standards	Timely Remedy of Category 1 Defect	Remedy a Category 1 Defect (Permanent Remedy) within the Defect Remedy Period.	Defect Remedy Period	N/A	2
2.39	Inspections, Defects and Standards	Timely Remedy of Category 2 Defect	Make permanent remedy of a Category 2 Defect within the Defect Remedy Period.	Defect Remedy Period	N/A	1
2.40	Inspections, Defects and Standards	Prevent occurrence of Defect	Prevent a Category 2 Defect from deteriorating into a Category 1 Defect.	N/A	N/A	1
2.41	Inspections, Defects and Standards	Maintenance of Traffic Requirements	Perform O&M Work After Construction in compliance with any of the Developer's commitments (other than those in respect of lane Closures or Closures which are subject to Operating Period Closure Deductions in accordance with Schedule 6) in respect of maintenance of traffic as set out in the Developer's Maintenance Management Plan.	1	N/A	4
2.42	Inspections, Defects and Standards	Timely Performance of Renewal Work	Perform Renewal Work at the time or in the manner set forth in the Developer's Renewal Work Plan and in accordance with the Renewal Work Schedule.	14	7	1

Table 6A.2 – Operating Period Noncompliance Events

Ref	Activity Type	Heading	Noncompliance Event – Failure to:	Cure Period (days)	Grace Period (days)	Number of Points
2.43	Deliverables	Documentation for DBE plan	Comply with the requirements of Schedule 14, Section 4.1.1.d.iv regarding DBE/WDP Report and tracking.	7	N/A	2
2.44	Deliverables	On the job training	Comply with the requirements of Schedule 14, Section 4.1.1.d.v regarding OJT and local hiring tracking.	7	N/A	1

Schedule 7
Compensation on Termination

[*To be provided in a subsequent Addendum*]

Schedule 8
PROJECT ADMINISTRATION

1. GENERAL REQUIREMENTS

The Developer shall be solely responsible for the management and administration of the Work, coordinating all activities necessary to perform the Work, and reporting and documenting all Work and ensuring the quality of the Work in conformance with the Agreement. The Developer shall satisfy all functional needs and characteristics of Project administration and this Schedule 8.

2. PROJECT MANAGEMENT PLAN

2.1 General Requirements

2.1.1 The Developer shall submit a Project Management Plan (PMP) that encompasses the Term of the Project Agreement, for Acceptance by the Department, prior to the issuance of NTP1, which is consistent with and expands upon the draft Project Management Plan submitted with the Proposal. The PMP shall provide clear detail of the Developer's overall approach to its team organization, structure, and management processes, and shall describe the scope, goals, and objectives of Project approach and intended results and be fully compliant with all provisions of the Project Agreement. The PMP shall identify by signature page and date, the title of the qualified professionals who are responsible for planning, reviewing, approving, reporting, monitoring, controlling, implementing, revising, and issuing the PMP, including revisions. At a minimum, the PMP shall include the following (where applicable relating to both Developer and its Subcontractors but also, where applicable, clearly identifying the division of roles and responsibilities between the Developer and its Subcontractors):

a. An organizational chart and description, indicating the Developer's overall team structure including all Key Personnel, management staff and their reporting relationships for all Work;

b. A design organizational chart and description, indicating the roles, responsibilities and structure of the Developer's design staff, down to and including discipline leads and the staff positions proposed in each discipline;

c. A construction organizational chart and description, indicating the roles, responsibilities and structure of the Developer's construction staff, down to and including field superintendents and the staff positions proposed under each field superintendent for the Work for all shifts;

d. A quality management organizational chart and description, indicating the roles, responsibilities and structure of the respective quality management, Process Control and IQC staff (Developer and IQCF), down to and including field inspection, and testing for the Work for all shifts;

e. An Operations and Maintenance (O&M) organizational chart, and description, indicating the roles, responsibilities and structure of the O&M staff, down to and including the roadway,

drainage, bridge, tolling systems and Intelligent Transportation Systems (ITS) discipline leads for the O&M Work;

f. A design management process, including a description of how design personnel will interface with the Department, construction, quality management and O&M organizations, in accordance with the Schedule 8, Quality Management Plan requirements;

g. A construction management process, including the independence of Process Control (PC) personnel and activities from IQC personnel and activities, interface with the IQC and roles and responsibilities for approvals, Developer's coordination plan, the Developer's management approach, the construction management structure, identification of advanced Work, detailed delineation of work zones with identification of design and construction packages, and summary of major Project phases;

h. Description of key processes and their reference location within the Developer's Operations Management Plan and Maintenance Management Plan, in accordance with the Schedule 11 requirements, including a description of how design personnel will interface with Developer's construction, Process Control, IQC and O&M organizations in accordance with the Schedule 8, Quality Management Plan requirements, process for inspections and notifications of issues of non-compliance to Department, and processes and timeframe for providing applicable cures for nonconformance;

i. Detailed description of the interface between the design and construction resources and the allocation of design and construction staff to implement the Project;

j. Process for addressing constructability, durability, maintainability and environmental compliance in the Work;

k. Description of key processes and their reference location within the Developer's Durability, in accordance with the requirements in Schedule 8 and to meet the requirements of Schedule 12 (*Handback Requirements*). This will include a description of how design personnel will interface with Developer's construction, Process Control, IQC and O&M organizations in accordance with the Quality Management Plan requirements in Schedule 8 to ensure durability in the design process.

l. Description of key processes and their reference location within the Developer's Quality Management Systems Manual, in accordance with the Schedule 8 requirements, for control of the Release for Construction (RFC) drawings through the Construction Period including making changes to the design during construction and ensuring engineering review of the new design and compliance with the Project Agreement. Processes shall demonstrate how the Department and the Developer's design team are involved in the review and acceptance of deviations from the RFC drawings;

m. Process for construction closeout including the Developer's approach to satisfaction of Milestone Completion Conditions, Substantial Completion Conditions, Final Acceptance Conditions, and management of Punch Lists;

n. Description of key processes, and their reference location within the Developer's Safety Management Plan, in accordance with Schedule 8 requirements, for both employees of Developer and its Subcontractors and the public, including the designation of a full time safety manager, training procedures, description of the subcontractor Health and Safety Plan, accident investigation procedures and exposure assessment;

o. Description of key processes, and their reference location within the Developer's Transportation Management Plan, in accordance with Section 2 of Schedule 10 Maintenance of Traffic requirements, including interface with the Department, City and County of Denver (CCD);

p. Description of key processes, and their reference location within the Developer's Strategic Communications Plan, in accordance with the Schedule 14 requirements, including interface with the Department, City and County of Denver (CCD), Governmental Authorities, regulatory agencies, Utility Owners, Railroads, other stakeholders and the public during the Work, at a minimum the following activities: plans and Permits review; progress, workshops, partnering and Utility coordination meetings; construction engineering and inspection; and public involvement and community input;

q. Description of key processes, and their reference location within the Developer's Environmental Compliance Work Plan, in accordance with the Schedule 17 requirements, including interface with the Department and any Governmental Authority;

r. Description of key processes, and their reference location within the Developer's Property Management Plan, in accordance with the Schedule 18 requirements, including processes for the security, hazardous materials assessment, demolition, debris removal, site clearing, storm water management improvements, and clean-up of building structures and property improvements acquired as part of the ROW for the Project;

s. Description of key processes for managing the Project's Disadvantaged Business Enterprise (DBE), Emerging Small Business (ESB), On the Job Training (OJT), and Buy America requirements, and their reference location within their respective Plans, in accordance with the Schedule 15 requirements;

t. Description of the Developer's key processes and approach to the Schedule Work Plan, in accordance with the Schedule 8 requirements, including schedule maintenance and required Submittals management, and Change management procedures; and

u. Developer's approach to non-compliance reporting, evaluation, and resolution with each of its Subcontractors and methodology on how this information will be reported to the Department, including in accordance with the Schedule 6, Part 6, Section 2 (*Noncompliance and Closure Database*) requirements.

2.2 Project Management Plan Updates

2.2.1 The Developer shall monitor and improve the effectiveness of its PMP and resubmit the PMP for Acceptance by the Department annually, upon the anniversary of its initial Acceptance by the Department, or more frequently should any of the following conditions exist:

a. A plan or procedure no longer adequately addresses the matters it was originally intended to address;

b. A plan or procedure does not conform with the Project Agreement;

c. An audit by the Developer or the Department identifies a deficiency in the PMP requiring an update;

d. Organizational structure changes require revision to the PMP;

e. The Developer is undertaking, or about to undertake, activities that are not covered within the current PMP; or

f. The Department requires the PMP to be updated at its request.

2.2.2 The Developer shall clearly identify in a cover sheet what changes were made in a PMP update to expedite the Department's review. Also, a redline copy and a final clean copy shall be submitted to the Department.

3. PROJECT SCHEDULING

3.1 General Requirements

The Department's opinions concerning the various scheduling documents and reports are not controlling over the Developer's independent judgment concerning the means, methods, and sequences of Construction Work that the Developer employs. All Work and activities of the Developer shall be scheduled and monitored by use of a Critical Path Method (CPM) Project Schedule using scheduling software compatible with Primavera P6 v7. Compatible shall mean that the Developer provided electronic file version of the Project Schedule may be loaded or imported by the Department with no modifications, preparation, or adjustments. All scheduling software settings within the scheduling/leveling dialog box shall remain 'default' unless otherwise Approved by the Department. In addition, any changes to the scheduling software settings that alter the scheduling calculations shall be clearly identified and provided as part of the schedule submittals. The Developer shall provide a Project Schedule for the Work in accordance with this Section.

3.2 Schedule Work Plan

3.2.1 The Developer shall provide a Schedule Work Plan that addresses all aspects of scheduling the Work and assigns responsibilities to positions within the Developer's organization. The Schedule Work Plan should be based on the description of the overall approach of scheduling the

Construction Work provided with the Proposal Schedule. The Schedule Work Plan shall be submitted for Approval by the Department, prior to the issuance of NTP1, and shall provide a description of the overall approach of scheduling the Work, including the following:

a. The Developer's approach to development, review, and coordination with the Department for Approval of the Project Schedules;

b. The Developer's organization and specific positions (including field personnel) that will be responsible for developing and progressing the Project Schedules and for PC and IQC of the Project Schedules, the personnel performance responsibilities and Developer coordination internally and with the Department for Project Schedules updates;

c. Developer's approach to updating and maintaining the Project Schedules to reflect the scheduled Work and how the Project Schedule will be utilized to progress the Work; and

d. Developer's approach to tracking the information necessary to update each Monthly Progress Schedule to reflect the exact manner in which the Developer executed the Construction Work.

3.2.2 The Developer may propose or the Department may require updates to the Schedule Work Plan. Changes to the Schedule Work Plan shall be submitted by Developer for Approval by the Department.

3.3 Project Schedules

3.3.1 The Work specified in this subsection includes preparing, progressing, revising, and submitting the Project Schedules;

3.3.2 The Project Schedules shall be developed consistent with the Accepted Work Breakdown Structure (WBS) and shall represent a practical plan to complete the Work before the Baseline Substantial Completion Date and the Final Acceptance Deadline, as applicable, and convey the intent in the manner of the prosecution and progress of the Work;

3.3.3 The Project Schedules shall include the planned execution of the Work in accordance with the Project Agreement. The Project Schedules shall include involvement and coordination with Utility Owners, Railroads, Governmental Authorities, engineers, architects, Subcontractors, and Suppliers in the development of the Baseline Schedule, Revised Baseline Schedule, and updating of subsequent Monthly Progress Schedules;

3.3.4 The Project Schedule shall mean any of the following schedules identified in this Section 3.3 (Project Schedules). If any ambiguity exists, which Project Schedule is meant shall be as determined by the Department.

a. Baseline Schedule

i. The Developer shall submit, for Approval by the Department, a Baseline Schedule. The Baseline Schedule shall be a CPM schedule with activity detail to WBS Level VI.

The Baseline Schedule shall conform to the Accepted WBS and include all Developer-defined WBS Level IV, V, and VI activities; and

ii. The Baseline Schedule shall be developed based upon the Proposal Schedule contained in Schedule 28, shall include the dates for the Key Milestones and shall be incorporated into the Project Agreement (such dates for which shall not be changed except by Department Approval). The Baseline Schedule shall detail the Developer's Activities for the Project from NTP1 through Final Acceptance. Activities representing Work during this period shall be sufficiently detailed to plan, monitor, and evaluate the progress of the Work. The Baseline Schedule shall represent conditions of the Project at NTP1.

iii. Once Approved, the Baseline Schedule shall be the base Project Schedule against which all progress of the Work shall be assessed. Once Approved, the Baseline Schedule shall not be modified. The Baseline Schedule shall be the basis against which the Monthly Progress Schedule shall be assessed.

b. Revised Baseline Schedule

Any revisions or changes to the Baseline Schedule proposed by the Developer, or required by the Department, shall be incorporated by the Developer into a Revised Baseline Schedule. Each Revised Baseline Schedule is subject to Department Approval prior to implementation. Each Revised Baseline Schedule shall have a unique name that includes a sequential revision number from the original Baseline Schedule. The Revised Baseline Schedule shall detail the then-current progress of Work, including the status of all activities, sequencing, and logic changes, and shall represent the Developer's best knowledge and planning at that time. Once Approved, each Revised Baseline Schedule shall be the basis for all subsequent Monthly Progress Schedules.

c. Float

i. Float shall be for the benefit of all Parties to the Project Agreement and not for the exclusive benefit of the Developer. The Developer shall not suppress or consume Float by extending activity duration or including dummy activities. Preferential sequencing shall not be permitted.

ii. The Department shall have the right to examine the identification of, or failure to identify, Float and Controlling Work Items on any Project Schedule in determining whether to Approve such Project Schedule.

3.3.5 Monthly Progress Schedules

a. The Developer shall submit Monthly Progress Schedules with Progress Reports submitted pursuant to Section 4 of this Schedule 8, unless otherwise Approved by the Department. At a minimum, the Monthly Progress Schedule(s) shall include the following current Construction Work data:

i. Detailed schedule of activities that clearly identify the Critical Path;

ii. Progress for the current period for all activities; and

iii. Actual start and finish dates of activities, physical percent complete, and Calendar Days remaining for activities in progress.

b. The data date for use in calculating the Monthly Progress Schedule shall be the first day of the following month. The Monthly Progress Schedule shall accurately reflect updated progress as of the effective date of the Baseline Schedule or Revised Baseline Schedule, forecast finish for in-progress activities, and reforecast early and late dates for remaining activities, and shall indicate the overall physical percent complete of the Project. If any actual dates are changed or corrected in any following month, a narrative must be included providing explanation of the change;

c. The Monthly Progress Schedule(s) shall be submitted monthly, and include additional, separate, filtered lists of activities and Construction Work elements included in the Monthly Progress Schedule to illustrate the following:

i. Coordination and accomplishment of Construction Work associated with Utilities and Railroads;

ii. Status of all Key Milestones as compared to the Baseline Schedule or Revised Baseline Schedule planned dates;

iii. Physical status of all Work as of date of the update;

iv. Actual progress relative to planned progress, organized by WBS;

v. Design document submittals for the upcoming period;

vi. All activities with 14 Calendar Days or less Float;

vii. 60 Calendar Day look ahead on all required Department Approvals and other applicable third party approvals;

viii. 90 Calendar Day look ahead sorted by WBS and activity early start dates;

ix. Critical items for Critical Path sorted by activity early start date; and

x. Time-scaled critical path network plot indicating the status of all activities as of the date of the update.

d. The Developer may modify a Monthly Progress Schedule without Department Approval, however the Developer must receive prior Approval from the Department for any changes to the Key Milestones, or any activities that require action or include commitments by the Department, including changes to the dates such activities fall upon. If the Department

provides comments to any Monthly Progress Schedule, the Developer shall address such comments to the Department's satisfaction prior to submittal of the subsequent Monthly Progress Schedule. The Monthly Progress Schedule shall include all information current as of the data date.

e. Record Schedule

The final Monthly Progress Schedule submitted shall include all Work completed through Substantial Completion and be identified by the Developer as the Record Schedule. The Record Schedule shall reflect the exact manner in which the Developer executed the Construction Work (including start and finish dates, activities, actual durations, sequences, and logic), and shall be signed and certified by the Developer's Project Manager and the Developer's lead scheduler as being a true reflection of how the Work was executed through Substantial Completion.

3.3.6 Schedule Requirements

a. All Float shall be shown on the Project Schedule on each schedule path.

b. The Project Schedule shall divide the Work into activities with appropriate logic ties to show the Developer's overall approach to planning, scheduling, and executing the Work. The duration and the logical relationships of the activities and summaries at Work phase level shall be based on the actual durations and relationships anticipated. The Developer shall not use calendar dates to "logically" begin or complete any activity unless those specified calendar dates are identified in the Project Agreement. The Developer shall allow for at least three workshop sessions with the Department during development of the Baseline Schedule and at least one workshop session for each Revised Baseline Schedule. For all Monthly Progress Schedules, the Developer shall meet with the Department at least once per month and as otherwise requested by the Department.

c. The Project Schedule shall accommodate the Right-of-Way Schedule in accordance with Schedule 18 Right-of-Way.

d. The Project Schedule shall accommodate Utility coordination in accordance with Schedule 10, Section 4 Utilities.

e. The Project Schedule shall accommodate Railroad coordination in accordance with Schedule 10, Section 10 Railroads.

f. Schedule Development

i. All Project Schedules and Monthly Progress Schedules shall include the following data:

A. Activity ID;

B. Activity description;

C. Start date (actual start date for started activities);

D. Finish date (actual finish date for completed activities);

E. Remaining duration (for those activities started but not completed);

F. Variance from Baseline Schedule or Revised Baseline Schedule start dates;

G. Variance from Baseline Schedule or Revised Baseline Schedule finish dates;

H. Total Float; and

I. Critical Path activities highlighted in red.

ii. Provide sufficient number of activities in the schedule to assure adequate planning and control of Construction Work, and to permit monitoring and evaluation of progress, and analysis of time impacts;

iii. Use CPM to determine controlling items of Construction Work. The Developer shall utilize retained logic for calculating all Project Schedules. Out-of-sequence Construction Work shall be itemized and described in monthly schedule narrative reports and discussed at monthly review meetings;

iv. Show the order in which the Developer plans to perform the Construction Work, with logical ties sufficient to demonstrate the Developer's overall approach to planning, scheduling, and executing the Construction Work;

v. Use activities, with the exception of the first and last activities, that have a minimum of one predecessor and a minimum of one successor activity;

vi. Not use unnecessary logic ties;

vii. Use durations and logical relationships based on the actual durations and relationships anticipated;

viii. Depict the sequence and interdependence of all activities required for the complete performance of the Work, beginning at NTP1 and concluding at Final Acceptance;

ix. Use all, and only, activities which are consistent with the Developer's WBS;

x. Identify all design packages intended to be included as Release for Construction (RFC) documents, which, at a minimum, shall have logical ties to the submittals and Construction Work anticipated for the respective design package;

xi. Show the phasing of the Construction Work, including RFC documents, submittal dates, subcontractor Construction Work, procurement, fabrication, preparation of

mock-ups, delivery, installation, PC, IQC, testing of materials and equipment, and any long-lead-time (over 60 Calendar Days) orders for materials or equipment;

xii. Include the Key Milestones, which shall each be assigned "finish no later than" constraint dates;

xiii. Depict the required coordination with, and work to be performed by other contractors, including any contractors performing Construction Work within or adjacent to the Site, and work from adjacent projects which may affect the Construction Work, Railroad Work, Utility Owners, third parties, Subcontractors, and Suppliers;

xiv. Depict and account for the acquiring of Permits and Governmental Approvals;

xv. Show all activities, of either the Department or third parties that affect progress of the Work. Include activities identifying Department Approval or Acceptance periods and other actions;

xvi. Contain no activity duration shorter than one Calendar Day, or longer than 30 Calendar Days, except for long lead time material procurements, as long as each phase of the procurement is identified as a specific activity;

xvii. Show Maintenance of Traffic (MOT) Activities;

xviii. Contain no unspecified milestones, Float suppression techniques, or use of activity durations, logic ties, and/or sequences deemed unreasonable by the Department;

xix. Use activities or calendars instead of duration lags, and contain no negative;

xx. Utilize a unique number for each individual activity;

xxi. Not reuse any activity number;

xxii. Include, in electronic and hardcopy format, a graphic representation in the form of a Gantt chart with an activity table of all activities;

xxiii. Comply with all requirements in Schedule 10, Section 2 Maintenance of Traffic for all closures documented by indicating the planned or actual start and completion of a closure using a level-of-effort activity; and

xxiv. Appropriately account for weather.

g. Schedule Management

i. Activities and their durations that represent Department actions or commitments shall be subject to the Approval of the Department. Once Approved, no changes to such activities, nor their start and finish dates, shall be made without Department Approval;

ii. Activity descriptions shall not be changed without Department Approval. Any proposed change to a description shall be clearly identified and discussed at monthly meetings. New activities shall be used to show changes in scope; and

iii. All Project Schedules and time impact analyses shall include a certification by the lead scheduler and Project Manager that the information presented is true and accurate and meets the requirements of the Project Agreement.

h. Schedule Narrative Report

i. The Baseline Schedule shall include a Schedule Narrative Report describing, at a minimum, the Developer's plan and schedule for achieving the Project Agreement requirements and objectives for all Work. The narrative shall describe the methods of operation, resources to be employed, time frames for Project Administration, design, and construction, and time frames for accomplishment of specified milestones and Key Milestones. A Resource Plan shall be included, which shall document in detail the types and quantities of resources needed to prosecute all aspects of the Work;

ii. The Revised Baseline Schedule shall include a Schedule Narrative Report describing the Developer's plan and schedule for achieving the remaining Agreement requirements and objectives for the Work. The narrative shall describe the methods of operation, resources to be employed, time frames for the design and construction, and time frames for accomplishment of specified milestones and Key Milestones. A Resource Plan shall be included, which shall document in detail the types and quantities of resources needed to prosecute all aspects of the Work; and

iii. The Monthly Progress Schedule shall include a Schedule Narrative Report describing the status of the Work, in detail. The narrative shall include progress made that period, plans for the forthcoming period, all potential delays and problems, their estimated effect on the Project Schedule and overall completion, and whether the Project is on, ahead of, or behind schedule. The Monthly Progress Schedule narrative shall not be considered to be notification of delays, request for Changes, or other issues.

3.3.7 Work Breakdown Structure

a. The Developer shall submit to the Department a detailed WBS along with its Baseline Schedule. The Baseline Schedule shall include a detailed, organized hierarchical division of the WBS for completing each element of the Work. The Accepted WBS shall be the basis for organizing all Work under the Project Agreement, and shall be used as a basis for the Project Schedules, and other control systems;

b. The WBS shall conform to the levels in Table 1. Table 1 represents Levels I through VI, which are the minimum levels of the WBS that all schedule information shall roll up. However, further detail shall be provided by the Developer for Levels IV, V, and VI to ensure a clear understanding of the Project Agreement. The Developer shall submit its

Baseline Schedule broken down to the WBS Level V activities. Additionally, a roll-up of activities unique to design, construction, and maintenance shall be shown at Level IV;

c. The Accepted WBS shall be the basis for organizing all Construction Work under the Project Agreement, and shall be used to structure the design, and other control systems. The Developer shall submit its Baseline Schedule specifying WBS activities and proposed Construction Work segments. The Baseline Schedule shall be submitted for Approval by the Department, prior to the issuance of NTP1; and

d. A methods statement shall be prepared for each of the Level III WBS elements listed in the Project Schedules for all Critical Path items in the Project Schedules, and for any feature not listed in the Project Schedules that the Developer considers a Controlling Work Item for timely completion. The methods statement shall be completed in accordance with the CDOT *Standard Specifications*.

Table 1 WBS Levels

Level I:	**I-70 EAST PROJECT AGREEMENT PROGRAM**
Program Level – Department use only: The summary of all program components	
Level II:	**MAJOR PROGRAM ELEMENTS**
• Major Program elements: • Activities of the Developer. This is the Developer's highest level	
Level III:	**CONSTRUCTION WORK COMPONENTS**
Developer Construction Work Components: • Breakdown of major components of the Construction Work: ○ Mobilization ○ Construction Work Management ○ Quality Management Plan ○ Changes/construction modification orders ○ Disadvantaged Business Enterprise/Emerging Small Business Plan ○ Workforce Development Plan ○ Strategic Communications ○ Environmental Management ○ Drainage ○ Utilities ○ Structures ○ Railroads ○ Right-of-Way ○ Aesthetics ○ Fire & life safety ○ Deck cover park plans ○ Maintenance of traffic ○ Roadway ○ ITS ○ ETC ○ Warranty	

Level IV:	**CONSTRUCTION WORK SUBCOMPONENTS**
Developer Contract Subcomponents: • Breakdown of all major subcomponents of the Construction Work (i.e. level III WBS), at a minimum, the Developer shall include Level IV elements. • The Developer to define certain activities at this level (e.g., work areas)	
Level V:	**CONSTRUCTION WORK SUBCOMPONENTS AND WORK ACTIVITIES**
Breakdown defined by the Developer: • As-Built plans • Minor subcomponents (e.g., bridge substructures & superstructures, etc.) • The Developer to define certain activities at this level (work areas, phases, etc.) • Maintenance during construction (duration based)	
Level VI:	**WORK SUB-ACTIVITIES**
Breakdown defined by the Developer: • The Developer to define all activities at this level	
Schedules: • No specific Project Schedules are required at this level. However, level VI activities are required as a component of the Monthly Progress Schedule.	

4. PROGRESS REPORTING

4.1 Progress Submittals

The Developer shall submit Progress Reports to the Department each month. Each Progress Report shall be submitted for Acceptance within 10 Working Days following prior month's end. Progress Report submittals shall be done electronically.

4.1.1 Progress Report Content

The Progress Report shall include:

a. A Cover Sheet indicating the following information:

i. Project number and title;

ii. Progress Report number (numbered consecutively starting with "1");

iii. Period covered by the Progress Report (specific calendar dates);

iv. Total percent complete to date for the Construction Work as a whole and for each Level III WBS activity; and

v. Nonconforming Work.

b. Additionally, each monthly Progress Report shall include the following:

i. Brief narrative description of Level V activity and progress for the Construction Work as a whole, including maintenance, design, and construction;

ii. Identification of start and completion dates;

iii. Update of progress with respect to Utilities;

iv. Update of progress with respect to Right-of-Way;

v. Identification of whether any completion and deadlines are achieved or revised during the period;

vi. Summary of PC and IQC program efforts, including results of design reviews;

vii. Identification of problems and issues that arose during the period and remaining problems and issues to be resolved;

viii. Summary of resolution of problems and issues raised in previous Monthly Progress Reports or resolved during the period;

ix. Summary of Construction Work accidents (frequency and severity) and the management of those accidents through the SMP;

x. Identification of critical schedule issues and proposed resolution;

xi. Discussion of schedule variations from Key Milestones that have slipped or improved;

xii. Monthly update and discussion of previous month's Strategic Communications activities, in accordance with the requirements of Schedule 14, including: stakeholder meetings, public meetings, community events, complaint tracking log, and outreach tools employed;

xiii. Monthly Environmental Compliance Work Plan (ECWP) activities report in accordance with Schedule 17;

xiv. Monthly DBE/Workforce Development Plan (WDP) Report and tracking; and

xv. Progress photographs.

c. The Progress Report format shall be Approved by the Department, and jointly established through consultation with the Developer, within 10 Working Days after NTP1. The Progress Report shall be on Developer 8.5 x 11 inch letterhead;

d. The status date of the Monthly Progress Schedule is the last day of each month. The data date for use in calculating the Monthly Progress Schedule shall be the first Working Day of the following month;

e. The Developer shall make all corrections to the Monthly Progress Schedule requested by the Department and resubmit the Monthly Progress Schedule. If the Developer does not agree with the Department's comments, the Developer shall provide written notice of disagreement within five Working Days from the receipt of the comments. The items in disagreement shall be resolved in a meeting held for that purpose;

f. Certification by the Developer's Project Quality Manager. The Developer shall submit a certification signed by its Project Quality Manager certifying that:

i. All Construction Work, including that of designers, sub-contractors, suppliers and fabricators has been checked and/or inspected by the Developer's PC and IQC program staff, and that all Construction Work, except as specifically noted in the certification, conforms to the requirements of the Project Agreement;

ii. The Quality Management Plan (QMP) and all of the measures and procedures provided therein, are functioning properly and are being followed; and

iii. All safety critical work, in conformance with the Safety Management Plan (SMP) as further described in the Project Special Provisions set out in Appendix A to this Schedule 8, has been reviewed and sealed by the professional engineer of responsible charge before construction begins. Safety critical work is defined by the CDOT Revision of Section 107 – Performance of Safety Critical Work, included at the end of this Section.

g. Maintenance Progress Report. The Developer shall submit to the Department the current Maintenance Progress Report simultaneously with the monthly Progress Report.

4.1.2 Progress Status Meetings

A Progress Status Meeting shall be conducted each time a Monthly Progress Report is made. The meeting shall be used to verify, address and finalize the following:

a. Actual start dates;

b. Actual and planned completion deadlines for Key Milestones;

c. Activity percent complete;

d. Incorporation of Approved Change Orders;

e. Status of outstanding Nonconforming Work;

f. Work performance;

g. Monthly Progress Schedule, including changes from previous month's Progress Schedule;

h. Critical Path(s);

5. GOVERNMENTAL APPROVALS TRACKING

5.1 Governmental Approvals tracking list

5.1.1 No later than 30 Working Days after the Project Agreement Date, and thereafter on each anniversary of such date, Developer shall submit to the Department a list (the "Governmental Approvals List") of all Governmental Approvals and Permits that are required in respect of Work that:

a. Have been or will be applied for within the next 12-month period;

b. Have previously been obtained and are in effect; and

c. Have expired or been terminated during the prior 12-month period.

5.1.2 The Governmental Approvals List shall identify the:

a. Date on which any Governmental Approval or Permit application was made;

b. Date on which any Governmental Approval or Permit is expected to be or was obtained;

c. Date on which any Governmental Approval or Permit expired or was terminated; and

d. Anticipated date for any expiration or renewal for any Governmental Approval or Permit.

5.1.3 As soon as reasonably practicable following a request to do so, Developer shall supply free of charge to the Department a copy of any document or documents referred to in such list.

6. QUALITY MANAGEMENT

6.1 General

6.1.1 The Developer shall be responsible for implementation and maintenance of an effective quality program to manage, control, document and assure all obligations of the Developer comply with the requirements of the Project Agreement. The Developer shall develop and submit a comprehensive Quality Management Plan (QMP) that is consistent with and expands upon the draft Stage 1 QMP and draft Stage 2 QMP submitted in the Proposal. The QMP shall document the Developer's commitment to quality, and all quality requirements of the Project Agreement. Processes and procedures established in the QMP shall comply with International Organization for Standardization (ISO) 9001:2008, or equivalent ISO standard in effect on the date the QMP is submitted. The QMP shall encompass all Work performed by the Developer and Subcontractors of all tiers. The Developer shall obtain the Department’s Approval of the QMP in two stages: Stage 1, Approval of all non-construction related procedures and plans; and Stage 2, Approval of all construction-related procedures and plans.

6.1.2 The QMP shall delineate how the Developer will ensure that all disciplines, aspects, and elements of the Work shall comply with the requirements of the Project Agreement.

6.1.3 The QMP shall cover temporary and permanent components of the Work.

6.1.4 The QMP shall include procedures and methods that define how the Developer will collaborate with the Department through the Department's quality assurance oversight program as described in Section 6.6 of this Schedule 8.

6.1.5 The QMP shall describe the Developer's quality policy, approach to Process Control (PC) and Independent Quality Control (IQC) relative to design, construction, and Work management, quality improvement, quality personnel, and training in the QMP. The QMP shall list procedures for meeting all requirements of the Project Agreement. The Developer shall submit the Stage 1 QMP for non-construction related Work to the Department for Approval prior to issuance of NTP1. The QMP for all remaining Work (Stage 2) on the Project must have the Department's Approval prior to the issuance of NTP2. Any subsequent addenda to the QMP, required during execution of the Work, shall require the Department's Approval prior to implementation.

6.2 Administrative Requirements

6.2.1 Quality Systems Procedures shall adhere to the following requirements:

a. Be consistent with the requirements of this Section 6.2.1 of this Schedule 8 and Developer's stated quality policy.

b. Include all Work methods and the enforcement and implementation of these work methods through best practice. However, it is inevitable that situations will arise that require a departure from the norm. These conditions shall be anticipated in the procedures and shall allow for control of these activities.

c. Define the liaison and interface between the quality organization and the design and construction arms of the Developer.

d. The quality procedures shall, as a primary objective, be written with the intent of gaining employee understanding of the system.

e. Describe to the rationale for the procedures selected and, if the procedures do not address every provision of this Section 6.2.1 of Schedule 8, to explain why the standard is not applicable in their particular situation.

f. The following list of procedures (items i through xxi) shall serve as the starting point for defining Developer's quality management system:

i. Procedure for the preparation, control, and distribution of the Quality Management Plan;

ii. Scope;

iii. Key Personnel;

iv. Organizational/technical interfaces;

v. Design input requirements;

vi. Design output requirements (deliverables);

vii. Design Reviews;

viii. Department participation;

ix. Levels of responsibility and authority;

x. Procedure to control, verify, and validate the design;

xi. Procedure for document issue, approval, and revision;

xii. Procedure for the identification of, and where required by Project Agreement, the traceability of, deliverable items, such as Release for Construction Documents and As-Builts;

xiii. Procedure for the verification and control of computer programs used in design;

xiv. Procedures for inspecting, testing, and calibrating equipment;

xv. Procedures for handling Nonconforming Work;

xvi. Procedures for environmental compliance;

xvii. Procedures for corrective/preventive actions;

xviii. Procedures for handling storing, packaging, tracking and submitting Deliverables;

xix. Training processes;

xx. Procedures for internal quality audits; and

xxi. Procedure for management review.

g. The implementation of the quality system shall be demonstrated by internal quality audit reports, the trending of nonconformance, records of root-cause analysis, records of corrective and preventive actions, and records of Department audits and observations.

h. Documented procedures may make reference to specifications that define how an activity is performed. Procedures shall describe the process steps of what needs to be done and work instructions shall prescribe how it is to be done

6.2.2 Quality Policy

a. The Developer shall develop a written policy for quality, including objectives for, and its commitment to, quality. The Developer's executive management shall ensure that this policy is implemented at all levels of the Developer's organization.

b. The Developer shall publish and post a statement of its commitment to quality and the organization's quality objectives in several locations throughout the Project Office and the Site. The statement shall explain the Developer's commitment to quality and the responsibility the Developer has for assuring that it meets the quality requirements included in this Schedule.

c. The quality policy statement shall be made known to and understood by all Developer employees, sub-consultants, Subcontractors, and Suppliers. The Developer shall conduct and document a formal training program for all Developer employees, sub-consultants, Subcontractors, and Suppliers on the quality policy prior to their participation in activities monitored by the Developer under the QMP.

d. The QMP shall include the Developer's executive management's quality policy. The QMP shall delineate the procedure used by the Developer's executive management to implement the Developer's quality policy.

6.2.3 Quality Planning

a. The Developer shall provide evidence of quality planning that ensures specific requirements of the Project Agreement have been identified and incorporated into the documented quality system. Department's requirements represent the minimum requirements.

b. The Developer shall perform IQC inspections during all phases of the Work from NTP1 until Final Acceptance to assure that the Work meets, and is being performed in accordance with, the Project Agreement.

c. The Developer shall include in the QMP its planning methods to meet the requirements of the Project Agreement. The Developer shall include, at a minimum, the activities below in its quality planning efforts to meet the Project Agreement requirements for the Work:

i. Define and develop quality objectives for the Work;

ii. Identify the necessary processes, resources, and IQC personnel that are needed to assure that Developer obligations meet the requirements of the Project Agreement, including, but not limited to, design, construction, Environmental Compliance, Strategic Communications requirements, maintenance of traffic requirements, safety, Disadvantaged Business Enterprise (DBE)/Workforce Development, training, project management processes, and the QMP;

iii. Ensure the compatibility of design, construction, installation, public information, inspection, and testing procedures;

iv. Develop and maintain up to date procedures for PC, IQC, and quality improvement;

v. Identify and define all measurable Project Agreement requirements;

vi. Identify quality hold points for Developer IQC testing and inspection and to allow the Department the opportunity to perform its owner verification responsibilities;

vii. Identify, define, and implement standards of workmanship for all applicable work features (e.g., concrete finishing);

viii. Identify, define, prepare, and maintain quality records and quality plans for all elements of design, including, but not limited to, Wet Utilities, architectural, civil, structural, geotechnical, survey, hydraulic, environmental, traffic, safety, Right-of-Way (ROW), and temporary Work;

ix. Develop a procedure for preparation, control, Approval, and distribution of the QMP;

x. Develop a procedure for IQC auditing to ensure the Developer, Subcontractors, and Suppliers of material understand and are effectively implementing the QMP;

xi. Develop a procedure for corrective and preventative actions regarding quality compliance and implement the quality improvement plan to address corrective Work;

xii. Develop a procedure and ensure the Developer's executive management reviews the QMP at planned intervals to ensure its continued suitability, adequacy and effectiveness. Such reviews should include PC/IQC results, owner verification results, status of corrective/preventive actions, follow-up items from previous management reviews, changes to the QMP, and recommendations for improvement;

xiii. A systemic process for ensuring quality regardless of production or scheduling needs.

6.2.4 Process Control

a. The Developer shall be responsible for establishing, documenting, and implementing, a PC program. The PC program shall be described in the QMP and shall include all procedures necessary for the Developer to control the quality of its production processes to meet the requirements of the Project Agreement. The Developer shall develop a testing and inspection schedule to control production processes. The Developer shall conduct examinations of the quality of workmanship to confirm that all Work is being performed in accordance with all Project Agreement requirements. Appropriate follow-up inspections, sampling, and testing of materials shall be performed as each item of Work progresses to assure consistency in workmanship, compliance with Project Agreement requirements, (including design and construction documents), and satisfactory performance of the Work in service.

b. Construction PC materials testing activities shall utilize statistical analyses of material test results, including mean, variance, range, and running averages; measurements; clearances; and interactions between PC and IQC. The results of these activities shall be used by the Developer to set up control charts to monitor and track variations in materials over time. The control charts and the analytical results on which they are based shall be provided to the Department within 24 hours when requested.

c. Tests or inspections performed by production or PC personnel as part of the PC process shall not be used to satisfy the IQC requirements.

6.2.5 Control of Inspection, Measuring, and Test Equipment

a. Developer shall establish and maintain documented procedures to control, calibrate, and maintain inspection, measuring, and test equipment – including test software – used by Developer to demonstrate the conformance of product to the specified requirements. Inspection, measuring, and test equipment shall be used in a manner that ensures that the measurement uncertainty is known and is consistent with the required measurement capability.

b. Developer shall secure for the Project an independent Quality Control Firm (IQCF) which shall be an independent engineering/testing firm employed by the Developer responsible for administering and managing the construction IQC Inspection, sampling, and Testing. The IQCF and any Subcontractors or sub-consultants thereto must not be a Developer-Related Entity or any Affiliate thereof.

c. The Developer shall establish, document and implement an IQC program. The Developer shall include in the QMP the methods and procedures by which the Work will be certified by the Developer as complying with the requirements of the Project Agreement.

d. The IQC program shall be separate from the Developer's PC program.

e. At a minimum, the IQCF testing shall include the observations, measurements, and documentation specified in the CDOT *Field Materials Manual* and its Frequency Guide Schedule for minimum materials sampling, testing, and inspection for all quality acceptance tests required. The IQCF shall document the results and show if the test passed or failed based on the "pass/fail criteria" established in the Project Agreement. The IQCF shall include failing tests results in the test documentation.

f. IQC personnel shall not participate in any PC activities and shall be independent of the PC personnel.

g. The Developer shall identify in the QMP all necessary resources and personnel to perform all IQC activities required to ensure all Work meets the requirements of the Project Agreement. The QMP shall identify the construction quality hold points for IQC testing and inspection and shall describe how the Developer will notify the Department so that it may have the opportunity to perform its owner verification responsibilities.

6.2.6 Quality Improvement

a. The Developer shall establish, document, and implement a program for quality improvement. The Developer shall include in the QMP the methods for identifying, analyzing, evaluating, and implementing solutions to continuously improve quality. The QMP shall establish and maintain specific procedures to ensure a successful Quality Improvement Program.

b. The Developer shall schedule and perform internal quality audits on the basis of the status and importance of the activity to be audited. The Developer shall conduct weekly quality meetings with affected Developer staff including construction specialty leads, and the Department to discuss open Nonconformance Notices (NCN)s/Nonconformance Reports (NCR)s and quality issues. All unresolved quality issues, including but not limited to NCRs and owner verification NCNs, shall be discussed at these meetings, until resolved. The Developer shall submit an updated Nonconforming Work log to the Department weekly and shall use the log to look for Nonconforming Work trends to determine if Corrective Actions are needed.

c. The Developer shall ensure timely implementation of the necessary Corrective Actions to improve any nonconformance found during audits. The Developer's follow-up activities shall ensure the implementation and effectiveness of the Corrective Action taken. Corrective Actions shall identify the root causes of deficiencies and shall be developed, implemented, and tracked to prevent the recurrence of future nonconformance. Corrective Actions shall be monitored through review of documents, surveillance, or follow-up audits. The Developer shall keep records of Corrective Actions together with the respective audit records and submit those records to the Department upon request.

d. The Developer shall consider the Department's verification audits and the overall project goals to determine where Developer quality improvement audits shall be performed and potential Corrective Actions to be implemented.

6.2.7 Quality Personnel

a. The Developer's executive management shall have overall responsibility for success of the QMP. The Developer's executive management shall have the responsibility to ensure that personnel performing PC and IQC activities have the appropriate education, training, skills, and experience to meet the requirements of the Project Agreement. The Developer shall designate a Project Quality Manager (PQM) who shall not report to Developer's Project Manager, but shall be directly responsible to and report to the Developer's executive management. The PQM shall provide all final checks, approvals, and certifications for quality. The PQM shall be responsible for assuring, certifying, and providing documented evidence that the Work meets the requirements of the Project Agreement. The PQM shall have the authority and responsibility for the success of the Developer's quality program, and shall ensure that authority and responsibilities are defined and communicated within the organization.

b. The PQM shall be the primary point of contact to the Department for all issues relating to Developer's Quality Management Plan, including preparation, review, implementation, and updates. The PQM, irrespective of other responsibilities, shall have defined authority and responsibility for the following:

   i. Ensuring that a quality system is established, implemented, and maintained;

   ii. Reporting on the performance of the quality system to Developer's executive management for review and as a basis for improvement of the quality system; and

   iii. Direct supervision of the IDQM and IQCM and their respective staffs.

c. The Developer shall assign an Independent Design Quality Manager (IDQM) that reports directly to the PQM and shall be responsible for all design quality control activities for the Work. The Developer shall identify a Design Process Control Manager (DPCM) for all design activities. The DPCM shall be responsible for all design PC activities. The IDQM shall not be involved with scheduling or production activities, and shall report directly to the PQM. The IDQM shall ensure that the methods and procedures contained in the Approved QMP, related to design, are implemented and followed by the Developer, subcontractors, fabricators, suppliers, and vendors in the performance of the Work.

d. The Developer shall assign an on-site Construction PC Manager (CPCM) who shall be responsible for management of the PC aspect of the QMP. The CPCM shall not be involved with scheduling or production activities, and shall report directly to the Developer's management team. The CPCM shall ensure that the methods and procedures contained in the Approved QMP, related to construction, are implemented and followed by the Developer, subcontractors, fabricators, suppliers, and vendors both on-site and off-site in the performance of the Work.

e. The Developer shall assign an on-Site Independent Quality Control Manager (IQCM) who shall be an employee of the IQCF and shall be responsible for management of the IQC aspect of the QMP. The IQCM shall report to the PQM and to the Department. The IQCM shall not report to any person or party directly responsible for design or construction production.

f. The IQCM and CPCM shall both have or obtain the American Society for Quality (ASQ) certification as Quality Inspector, Quality Engineer, or Manager of Quality as an NTP2 Condition.

g. The Developer's PQM, IQCM, IDQM, CPCM, and DPCM shall review and approve the QMP prior to submittal to the Department. The Developer shall assure, certify and provide documented evidence that the Work meets the requirements of the Project Agreement. At a minimum, the PQM shall report the status of the Work's quality monthly to the Department.

h. All construction IQC testing personnel and PC testing personnel performing concrete and hot bituminous pavement process control tests shall meet the standards established in Section CP-10 of the CDOT *Field Materials Manual*.

i. The Developer shall ensure that personnel performing Work shall have the education, training, skills, and experience to meet the requirements of the Project Agreement. The Developer shall maintain appropriate personnel records that may be examined by the Department upon request.

6.2.8 Training

a. The Developer shall establish and maintain documented procedures for identifying training needs and requirements and shall provide training of all personnel performing activities affecting quality. Personnel performing specific assigned tasks affecting quality shall be trained in the specific plans, processes, and procedures as assigned in the QMP (e.g., Materials Testing and Inspection Plan (MTIP), Developer auditing procedures, etc.).

b. The Developer shall provide training to all personnel that may interface with the Department's oversight efforts (audit process) to ensure they understand their roles and responsibilities for cooperating and responding to audits.

6.3 Quality Management Plan Requirements

6.3.1 The QMP shall state the Developer's commitment to quality and provide a clear definition of the scope of activities and detail the methods to ensure the Work meets the requirements of the Project Agreement. The QMP shall list all deliverables to the Department, as required by the Project Agreement and this Section.

6.3.2 Responsibility and Authority

a. The Developer shall include in the QMP an organizational chart that illustrates a commitment to an effective quality program to ensure all Work meets the requirements of the Project Agreement. The QMP shall describe the hierarchy of the Developer's organization. The QMP shall graphically depict the principal quality participants, showing lines of responsibility, authority, communication, and interfaces with the Department; other involved agencies; and any other team members having a significant quality role, including subconsultants, Subcontractors, and Suppliers. The PQM, IDQM, DPCM, CPCM (and PC staff) and IQCM (and IQC staff) shall be shown on the organization chart to report to the Developer's executive management and be independent of the Developer's Project Manager. The Developer shall update the organization charts and distribute those charts to the Department when any changes to the organization are made.

b. The QMP shall describe the roles and responsibilities of the PQM, IDQM, DPCM, CPCM, IQCM, PC and IQC staff, and other key personnel; and shall describe their authority to implement quality improvements for the Work.

c. The Developer's PC/IQC managers and PC/IQC staff shall have no responsibilities in the management and production of the Construction Work and IQC personnel shall have the authority to stop Work that does not comply with requirements of the Project Agreement.

d. The responsibilities of all personnel who manage, perform, and ensure the quality of the Work include:

i. Initiate action to prevent the occurrence of Nonconforming Work;

ii. Identify, evaluate, and document quality problems;

iii. Recommend or initiate quality improvement solutions through established organizational channels;

iv. Ensure the implementation of quality improvement solutions; and

v. When Nonconforming Work is identified, stop all Work that is affected by the Nonconforming Work until the deficiency is corrected.

e. The PQM, IDQM, DPCM, CPCM, and IQCM shall have the following responsibilities defined in the QMP:

i. Facilitate compliance of Work with the requirements of the Project Agreement and the Approved QMP;

ii. Approve Developer quality processes and procedures;

iii. Provide adequate resources and trained personnel for PC and IQC activities;

iv. Ensure the adequacy and enforcement of quality procedures, processes, inspections, and tests for all Work;

v. Establish and implement procedures to control and ensure the Work performed by subconsultants, Subcontractors and Suppliers meet the requirements of the Project Agreement;

vi. Ensure the QMP is being implemented and report in writing regularly to the Developer's executive management regarding the status of the implementation of the QMP;

vii. Ensure that quality records are properly prepared, completed, maintained, and delivered to the Department, as required by the Project Agreement, to provide evidence of PC and IQC activities performed and quality results achieved;

viii. Ensure that IQC staff is independent of the Developer's Project Manager and regularly reports to the Developer's executive management; and

ix. Continually promote awareness of the requirements of the Project Agreement throughout the Developer's entire project organization.

6.4 Independent Quality Control

6.4.1 General

a. The Developer shall establish, document, and implement an IQC program. The Developer shall include in the QMP the methods and procedures by which the Work shall be certified by the Developer as complying with the requirements of the Project Agreement.

b. The QMP shall establish procedures for procuring services. The procedures shall include a review and approval process by the Developer for adequacy of specified technical requirements and the adherence to quality requirements.

c. The QMP shall describe the measures to be taken to ensure that Subcontractors, Suppliers and subconsultants meet, implement, document, and maintain the QMP requirements.

d. The selection of Subcontractors, Suppliers and subconsultants and the type and extent of control exercised by the Developer shall be dependent upon the type of product or service and, where appropriate, on records of Subcontractors', Suppliers' and subconsultants' previously demonstrated capability and performance.

6.4.2 Design Quality Control

a. The QMP shall include procedures that address all elements of design, including, but not limited to, Wet Utilities, architectural, civil, structural, geotechnical, survey, hydraulic, landscaping, aesthetics, environmental, traffic, safety, ROW, and temporary Work. The Developer shall identify in the QMP all applicable computer programs to develop and check designs.

b. The QMP shall describe how the design team schedules the design efforts, including task force meetings, design reviews, constructability reviews, design meetings, independent design checks, and a schedule for Release for Construction Documents and As-Built documents.

c. The Developer shall identify in the QMP design input requirements. The Developer shall perform ongoing audits of the design input requirements. The Developer shall maintain an accessible, centrally controlled design manual, database, or list that contains all relevant design inputs to be used by design personnel for the Work. The Developer shall provide a process in the QMP to ensure that the design inputs are communicated to, and accessible by, the relevant designers responsible for incorporating design inputs into the design. The Developer shall include in the QMP how changes to design inputs are identified, reviewed, and approved by authorized personnel prior to their implementation. The QMP shall also include:

i. Procedures to control and independently ensure that the design meets the requirements of the Project Agreement, including provisions for subconsultant's designs and configuration management activities;

ii. Procedures to identify and track design document deliverables;

iii. Procedures for Developer approval, tracking and recording revisions to Release for Construction (RFC) Documents. The Developer shall have a formal procedure for comment resolution included in the QMP;

iv. Procedures for Developer approval of RFC Documents; and

v. Procedures for approval of supplier-provided design drawings (e.g. shop drawings).

d. The Developer's design quality program shall include:

i. The Developer shall prepare preliminary (30% level) plan packages showing how the Developer's design meets the Schedule 10 Design and Construction Requirements obligations and Ultimate configuration accommodation requirements and submit to the Department for Acceptance. The preliminary level plan packages shall include:

A. Cover sheet;

B. Typical sections;

C. Plan and profile for the I-70 Mainline, CDOT Roadways, and Local Agency Roadways;

D. Structure Concept Plans including:

(I) Plans, elevations, and appropriate typical sections for each bridge type;

(II) Plan views of the structure identifying each bridge location and type. Include documentation of design vehicle turning movement analysis;

(III) Plan views of the structure identifying each wall location and type;

(IV) Description of conceptual solutions for complex structural problems identified by the Developer;

(V) Description of creative or innovative ways the design, construction, and/or choice of structural types will benefit and/or enhance the Project Schedule, quality, aspects of the structure; and minimize traffic impacts; and

(VI) Structure numbers for major structures.

E. Drainage structure general layouts;

F. Master drainage plan;

G. Master Drainage Report;

H. Master Water Quality Report;

I. Preliminary wall layouts;

J. Roadway cross sections at 50 foot intervals; and

K. The Developer shall perform periodic internal audits throughout the Work to ensure compatibility with the preliminary plans.

ii. Task Force Meetings

The Developer shall conduct weekly task force meetings to coordinate the design development within the Developer's organizations and with the Department and other affected agencies. As a minimum, the Developer shall prepare an agenda and conduct each meeting to discuss the status of the design, coordinate the design development between design disciplines, discuss constructability issues, and identify any questions associated with design requirements. The Developer shall take meeting minutes for all task force meetings and provide minutes to the Department for Acceptance within four Working Days after each meeting. The Developer shall provide final minutes to the Department via the Department's document management system on a monthly basis.

iii. Design Progress Review Meetings

The Developer shall hold design progress review meetings at certain stages of the design development process (e.g., 60%, 90% packages) and invite the Department to attend. The design progress review meetings shall be scheduled, conducted, and documented by the Developer. The Developer shall take meeting minutes and submit those minutes to the Department for Acceptance within four Working Days after each meeting.

iv. Final (100% Level) Plan Package

The Developer shall prepare the final (100% level) plan packages showing how the Developer's design meets the Schedule 10 Design and Construction Requirements obligations and submit to the Department for Acceptance. After the review period, the Developer shall conduct a comment resolution meeting with the Department.

v. RFC Documents and revisions to RFC Documents

RFC Documents shall be submitted for Acceptance by the Department. The RFC Documents shall include an MTIP. This plan shall give testing quantities and frequencies, and IQC inspection quality hold points to confirm minimum QMP requirements have been met. The Developer's Project Quality Manager shall approve the RFC Documents prior to RFC. The Developer shall submit one copy of the RFC Documents to the Department and make the RFC Documents available electronically prior to the Developer beginning construction. The Developer's IQC process for the RFC Documents shall be thoroughly documented in the Developer's QMP.

vi. Prior to release of RFC Documents for structure construction, the following items shall be required:

A. The independent design check shall have been completed per the current CDOT *Bridge Design Manual* and the original final structural design calculations shall be revised and corrected based on comments from the independent design check for the structural element to be constructed.

B. The Rating Package as defined in the CDOT *Rating Manual* shall be completed prior to release of the superstructure construction drawings.

vii. As-Built Documents

As-Built documents shall be submitted to the Department for Acceptance. The Department may audit As-Built documents to ensure completeness and compliance with the requirements of the Project Agreement. The Department shall not Accept As-Built documents until the Developer has addressed, resolved, and incorporated, to the satisfaction of the Department, any prior Developer or Department comments. The Developer shall ensure and provide documentation to the Department that all review comments have been addressed. The As-Built documents submittal shall include:

A. All plans reflecting RFC Documents or revisions to RFC Documents;

B. Resolution of nonconformance;

C. Design calculations;

D. Design reports;

E. Specifications;

F. Electronic CADD files, as specified elsewhere in the Project Agreement; and

G. Index summarizing all revisions to initial RFC Documents.

viii. The Developer shall include in the QMP a process for a licensed engineer in responsible charge for the design to prepare, review, and approve all changes, including field design changes, RFC Documents, and As-Built documents. The Developer shall maintain a master list of approved design changes. The QMP shall include a process to communicate design changes to those completing the Work on a timely basis consistent with the progress of construction activities.

ix. Environmental review

The Developer shall include in the QMP a process for Environmental review prior to submission of final (100% level) plan packages showing how the Developer's design meets the Environmental commitments and requirements of the Project Agreement, including the Developer's obligations under Schedule 17 (*Environmental Requirements*).

x. ROW processes and documents

All ROW processes, exhibits, plans, appraisals and appraisal reviews, value findings, and acquisition and relocation files shall undergo a Developer prepared IQC review process to ensure compliance with the Uniform Act, Colorado State Statutes, Department procedures and the Developer's obligations under Schedule 18 (*Right-of-Way*). In the event of an instance of nonconformance or an audit of the Developer's IQC process identifies a nonconformance with Schedule 18 requirements, the Department may elect and engage, at the expense of the Developer, a firm to conduct its own quality review. In such event, the Developer shall implement corrective and preventative actions to eliminate recurrence.

6.4.3 Construction Quality Control

a. The Developer shall perform and document all required construction PC and IQC activities necessary to control the Work. The QMP shall extend to both permanent and temporary Work (erosion control, traffic control, drainage, etc.). Records of inspection and testing activities shall be submitted to the Department via the Department's document management system. Records of materials testing shall be submitted to the Department provided Quality Records Database (QRD), a secure web-based application. The Department will provide user accounts and training. Materials test reports will also require entry of meta-data fields for analysis and comparison to the Department's verification test results.

b. As a minimum, the Developer's construction IQC Program shall include the elements defined below:

i. Certification:

The Developer shall include in the QMP a process to certify to the Department that the Work produced meets the requirements of the Project Agreement.

ii. Inspection:

The Developer shall include in the QMP, and submit to the Department for Approval, an MTIP that shall include detailed inspection procedures to be used in cases where inspections are to serve as the basis for verifying compliance with the requirements of the Project Agreement. The Developer shall submit all records of inspection and testing to the Department-provided QRD. The Developer shall conduct each inspection in accordance with the Approved QMP. The Developer shall document whether the inspections passed or failed based on the "pass/fail criteria" established in the procedure and the requirements of the Project Agreement; (e.g., concrete depth checks on deck pours, rebar clearance/size, locations, elevations, stationing etc.). The Developer shall include failing inspection results, when applicable, in the inspection documentation.

iii. Testing:

At a minimum, the Developer shall follow the CDOT *Field Materials Manual* and its Frequency Guide Schedule for minimum Materials sampling, testing, and inspection requirements identified under the column titled "Work Verification Sampling & Testing Frequency" for all IQC tests required. The Developer shall document the results in the QRD and show if the test passed or failed based on the "pass/fail criteria" established in the Project Agreement. The Developer shall include failing tests results in the test documentation. Independent Laboratories shall submit signed and certified test reports to the Developer not more than 10 Working Days after completion of the tests for all tests which require an independent Laboratory. The Department may witness any test conducted for Independent Assurance purposes. The Developer shall develop and maintain a current test log for all tests required by the Project Agreement. As a minimum, the Developer shall document results of tests in report format and include the following:

A. Project Agreement Project identification number

B. Identification of items tested

C. Quantity

D. Date and time test conducted

E. Location of items tested

F. Test procedure used

G. Name of technician

H. Acceptance criteria

I. Results - Acceptance or rejection

J. Authorized signature

iv. Certificate of Compliance and Certified Test Report:

A. The Developer shall include in the QMP a method of handling and documenting work/products accepted in the Work by Certificate of Compliance (COC) or Certified Test Report (CTR).

B. The Developer shall include in the QMP a method for documenting and tracking, on a basis consistent with Developer's Progress Reporting, compliance with Buy America Requirements of 23 CFR 635.410.

C. The Developer shall obtain COCs and CTRs prior to incorporation in the Work and maintain a complete log of all COCs and CTRs. The Developer shall make the log and all COCs/CTRs available for owner verification at any time during normal business hours and shall submit the COC/CTR log for Acceptance prior to Substantial Completion.

D. The Developer shall include in its COC/CTR log signed certification that all materials represented by each COC/CTR were installed in the Work. Certification shall be in accordance with requirements of the Project Agreement.

v. Quality Reviews:

The Developer's PQM or designated representative shall document formal reviews to verify that the Approved QMP is being effectively implemented.

vi. Environmental compliance in Construction:

The Developer shall include in the QMP a section detailing the IQC activities that will be performed to ensure compliance during construction of all environmental requirements. IQC staff oversight of all Schedule 17 Environmental Requirements elements that apply to construction is required. These elements include but are not limited to: construction air quality, construction noise, noxious weed management, landscape planting and establishment, water quality, protection of wetlands and other sensitive areas, hazardous materials and environmental hardscape elements such as noise walls.

6.4.4 Materials Testing and Inspection Plan

a. The Developer shall prepare and implement a MTIP as part of the QMP that includes the appropriate criteria, tests, and inspection requirements identified in CDOT's *Standard Specifications*, *Field Materials Manual*; Developer-prepared inspection checklists; and requirements as set forth herein.

b. The MTIP shall describe all of the proposed inspections and tests procedures, including products provided by suppliers during the manufacturing, receiving, and installation process, to ensure the requirements of the Project Agreement are met. The MTIP shall identify all inspections and tests required and include, at a minimum, reference to the requirements of the Project Agreement, frequency of the inspections and tests, and the Developer-prepared IQC processes. Where no inspections or test standard exists in any of CDOT's manuals, the Developer shall develop criteria, in writing, based upon the best-available industry standard information and technology.

c. The MTIP shall include procedures for delivery, handling, and storage of furnished products ensuring that they are properly handled and stored to prevent damage, deterioration, or theft. It shall also document procedures for stored items and materials consistent with the expected duration and type of storage, and procedures for monitoring special processes utilized in fabrication, assembly, and testing of specified products. Special processes are those requiring qualified/certified production, inspection, and test personnel to perform highly skilled work, such as welding, brazing, soldering, non-destructive testing, machining, coating, or plating.

d. The MTIP shall describe all IQC inspection and test activities to be carried out including quality hold points, and establish authority within the Developer's organization for releasing Work beyond the quality hold point. While the Developer shall notify the Department when Work has progressed to a quality hold point, it shall be the responsibility of the Developer's Quality Managers to verify that all requirements have been met prior to allowing the Work to progress.

e. The MTIP shall include a summary of activity-specific material quantities to document that the minimum sampling, testing, and inspection requirements have been met. This summary shall be performed and provided to the Department for Acceptance monthly. The Developer may follow the CDOT Form 250 as a minimum basis for their materials documentation record.

f. The MTIP shall include processes to control, calibrate, and maintain test equipment to ensure it meets industry standards and other applicable requirements. Test equipment used by the Developer shall be of a quality and capacity that ensures that measurements made are to levels of accuracy and precision that are required by the test procedure. The MTIP shall:

    i. Identify the test required and the accuracy required, and select the appropriate test equipment;

    ii. Define procedures to calibrate all test equipment prior to initial use and at prescribed maintenance intervals against certified equipment and measurement standards of the National Institute of Standards and Technology or other similar recognized technical standards customarily accepted in the industry. Where no standard exists, the basis for calibration shall be developed in writing based upon the best-available information and technology;

iii. Identify test equipment with a suitable indicator to show the calibration status of the test equipment;

iv. Maintain current calibration records for test equipment;

v. Define procedures to ensure that environmental conditions are suitable for calibrating test equipment;

vi. Define procedures to ensure that the handling and storage of test equipment is such that the accuracy and fitness for use is maintained; and

vii. Define procedures to safeguard test equipment, including test hardware and test software, from adjustments that would invalidate calibration settings.

viii. Identify procedures with respect to the paving for the Project that includes the following:

A. A thorough definition of pavement smoothness and quality, which shall be the same for all travel lanes and shoulders, and the identification of steps for maintaining these criteria, including defined hold points and potential corrective measures;

B. Detailed information on identification of potential issues affecting quality such as smoothness, dumping and batching;

C. Procedures for monitoring, minimizing and correcting for lane to lane roughness variation;

D. Procedures for the control of segregation in HMA paving, and process to address unacceptable segregation that includes, at a minimum, a stop work provision and root cause analysis prior to restart.

E. Procedures for dowel bar placement and Magnetic Imaging Tools (MIT) testing and auditing, including the Developer's obligation to provide additional test sections for MIT testing and auditing at the Department's discretion; and

F. A Portland cement concrete pavement (PCCP) plan for addressing noted issues with performance and procedures to correct such issues.

6.4.5 Quality Hold Points

a. Developer shall establish Quality Hold Points (QHPs) at stages of the construction progress to ensure Work is performed in accordance with Developer's Quality Management Plan and within the terms and conditions of the Project Agreement. As Work is accomplished, Developer's PQM, IQCM and IDQM shall meet with the Department to review documentation and procedures for PC/IQC, including but not limited to material certifications, daily inspection records, material testing results, survey results, permits, and

material placement records. Developer's PQM shall coordinate group members to ensure that QHPs are accomplished in a timely manner so that Developer is not delayed. When an identified QHP is accomplished and when notified by the PQM, Department will respond within four working hours to verify whether Work has been completed for the QHP. Notification to the Department that a QHP has been reached while Work is still being performed or not allowing adequate time to complete the QHP review and opportunity for adjustments (e.g., concrete trucks are queuing while reinforcement is still being placed and QHP is being reviewed for a specified unit) will result in the issuance of a Nonconformance Report.

At a minimum, Developer shall establish QHPs at the following stages of construction:

i. Environmental:

A. After the establishment of Water Quality BMPs, and prior to initial ground disturbance;

B. Upon completion of surveys for nesting birds and protected species, prior to ground disturbance, in accordance with Project Special Provision 240, Schedule 17 Environmental Requirements;

C. Upon completion of protection of environmental resources, in accordance with Schedule 17 Environmental Requirements, where fencing or other appropriate protection mechanism is required, prior to ground disturbance;

D. At the end of each month to review Developer's weekly and post-storm inspections; and

ii. Embankments:

A. After the completion of drainage and Utility Relocations and prior to backfill;

B. After clearing, grubbing, and excavation to check subgrade;

C. Per specifications for lift requirements at 5 foot intervals of embankment construction;

D. After the completion of mechanically stabilized earth (MSE) wall panel placement; and

E. At the completion of embankment placement; and

iii. Structures:

A. At the completion of placement for bridge deck reinforcement and prior to the placement of concrete;

B. At the completion of placement for abutment wall reinforcement and prior to the placement of concrete;

C. After the completion of pile-driving at each structure support, including pile-driving results and records;

D. At the completion of placement for footing reinforcement steel and prior to the placement of concrete;

E. At the completion of excavation for drilled shaft foundations and prior to concrete placement;

F. After setting rails for screed machine and prior to placing concrete overlays;

G. After the completion of the first component to receive specified aesthetic wall treatment/form liner and prior to proceeding with the construction of subsequent components; and

H. After the completion of every 500 feet of noise wall posts and panels.

iv. Utilities:

A. After the installation of direct-burial duct banks and prior to backfill operations; and

B. For concrete-encased duct banks, after the installation of conduits and prior to the placement of concrete.

C. For all Utility lines intended to transport pressurized materials and lines intended to carry liquids, after the installation and prior to the completion of pressure testing.

v. Paving and sidewalks:

vi. Before the placement of each course above subgrade on permanent roadway components;

A. Before the placement of each lift of asphalt or Portland cement concrete; and

B. Prior to the placement of concrete for sidewalks.

6.4.6 Reporting and Record-Keeping of Quality Documentation

a. The Developer shall maintain construction workmanship and materials quality records of all inspections and tests performed per the QMP. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of Nonconforming Work

and causes for rejection, etc.; proposed remedial action; and corrective actions taken. These records shall cover both conforming and Nonconforming Work, and shall include a statement that all supplies and materials incorporated in the Work are in full compliance with the Project Agreement.

b. The Developer's Quality Managers shall ensure that quality records are properly prepared, completed, maintained, and delivered to the Department, as required by the Project Agreement, to provide evidence of the quality activities performed and quality results achieved.

c. The Developer shall submit all IQC test measurements and test results, including failing results, and inspection records. The Developer shall submit test data and approved test results to the Department for Information using the QRD within 24 hours following the inspection or test completion. The responsible technician and the technician's supervisor shall sign the daily test reports.

d. The Developer's Quality Managers shall also maintain a daily log of all inspections performed for both Developer and sub-contractor operations. The daily inspection reports shall identify inspections conducted, dates of inspections, results of inspections, locations and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed. The responsible technician and the technician's supervisor shall sign the daily inspection reports. These daily inspection reports shall document the day's events, activities, and discussions in a format consistent with the requirements contained within CDOT's *Field Materials Manual* and *Construction Manual*.

e. To enhance coordination of the Department's Independent Assurance activities during construction, the Developer shall provide the Department with a weekly look ahead of specific scheduled construction activities designating location and planned quantities of materials to be placed, and protocols for identifying completed Work. The Developer shall provide the Department with the actual construction activities conducted during the previous week, designating location and quantities of materials that were placed.

6.5 Nonconforming Work

6.5.1 The QMP shall include procedures to develop and maintain a system to identify, control, remedy and report Nonconforming Work, including Nonconforming Work identified by the Department. The Developer shall remedy Nonconforming Work in accordance with the Approved QMP. The responsibility for review and authority for the disposition of Nonconforming Work shall be defined in the QMP. The Developer shall document the identification of Nonconforming Work by completing a NCR. Each NCR shall include:

a. Identification of Nonconforming Work, including tagging work products;

b. Evaluation of the Nonconforming Work;

c. Recommendation for rejection, "repair", or "use as is" dispositions, along with a signature block for the Department's Approval of the disposition. The Developer shall not commence with any repair or progress beyond Nonconforming Work until the Department has provided its Approval;

d. Cause of Nonconforming Work;

e. Proposed Corrective Action for its Correction and to prevent recurrence;

f. Responsibility for accomplishing Corrective Action through a Corrective Action Plan;

g. Schedule of Work with a date of remedy completion; and

h. Signature lines for the design or construction IQC Manager verifying that the Nonconforming Work Corrective Action remedy has been completed in accordance with the Corrective Action Plan.

6.5.2 The Developer's Project Manager shall approve the recommended remedy for the Nonconforming Work prior to its submittal to the Department.

6.5.3 The Developer's Project Quality Manager shall document the completion of any Nonconforming Work Corrective Action remedy, once accomplished, and promptly notify the Department so that the Department can perform its verification.

6.5.4 The QMP shall include procedures for controlling the use of Nonconforming Work including the tagging of Nonconforming Work products. Nonconforming Work product tags shall only be removed by the originator of the NCR or the originator's supervisor, and only when the Developer demonstrates to the Department that the Nonconforming Work product meets the requirements of the Project Agreement.

6.5.5 Within five Working Days of issuance of the NCR, the Developer shall respond to the Department in writing for all NCRs. The Developer's response shall identify how it proposes to remedy the work identified as nonconforming and the date by which the remedy shall be completed.

6.5.6 For verification and acceptance purposes, the Department will perform assessment of the Work. These efforts do not relieve the Developer of responsibility for checking all Work. The Department will forward all assessment reports and NCN to the Developer. Within five Working Days of issuance, the Developer shall respond to the Department in writing for all NCNs identified by importance (Level 1 or Level 2), through the Department's QRD. The Department shall provide user accounts and training for this purpose. The Developer's response shall identify how it proposes to remedy the Work identified as nonconforming and the date by which the remedy shall be completed. The Developer shall describe in the QMP its approach and methodology for resolving and responding to the Department's NCNs.

6.5.7 Corrective and Preventative Action

The QMP shall describe corrective and preventative action procedures that the Developer shall use to identify and improve processes that produce, or may produce, systemic Nonconforming Work identified by the Developer or by the Department. The Developer's corrective and preventative action procedures shall include:

a. Methods to investigate the cause of systemic Nonconforming Work and to determine what corrective action is needed to prevent recurrence;

b. Methods to analyze all processes, Work operations, quality records, service reports, and Department assessments/testing to detect and eliminate the possibility of systemic Nonconforming Work from occurring;

c. Methods to prioritize corrective and preventive action efforts based upon the level of risk to the quality of the Work;

d. Controls to ensure that effective corrective and preventative actions are taken when the need is identified; and

e. Methods to implement and record changes in procedures resulting from corrective and preventative actions.

6.5.8 Punch List Work

The Developer shall develop Punch Lists [and a Punch List log] as required by Part 7 of Schedule 3 to the Project Agreement. All Punch Lists and the Punch List log shall be completed by PC and IQC personnel. The Department and other affected agencies shall be invited by the Developer to attend walks of the Work to include items on Punch Lists. The Developer shall provide all Punch Lists [and the Punch List log] for Acceptance to the Department.

6.6 Quality Assurance Oversight

6.6.1 Department Quality Oversight

a. The Department retains the responsibility for acceptance of the Work as required in Title 23, Code of Federal Regulations, Part 637.

b. The Department will periodically audit the Developer Quality Management activities, including conducting independent verification sampling and testing to assess the Developer's compliance with the requirements of the Project Agreement. The Department reviews of sampled Work for Project Agreement compliance are defined as verification reviews. The four types of the Department verification reviews are:

i. Design verification reviews: The Department will perform design verification reviews on the products of design (drawings, specifications, and other design deliverables) on an ongoing basis during the Work. The Developer shall submit documents for design verification reviews to the Department for Acceptance a minimum of five Working Days in advance of review meeting.

ii. Construction verification Inspections: The Department will perform construction verification inspections on construction activities.

iii. Construction verification Testing: The Department will perform sampling and Testing of materials to validate the Developer IQC testing program. Verification Test results will be stored in the QRD.

iv. Process Audits: The Department will perform process audits on the implementation of all Developer Work activities, excluding design and construction. Such activities may include the requirements of the Project Agreement, such as public information, maintenance of traffic, environmental compliance, safety, project management processes, and meeting the requirements of the Approved QMP.

c. Verification reviews will entail the collection and documentation of objective evidence to determine whether the requirements of the Project Agreement have been met. The results of the Department verification reviews will be recorded by the Department and will be documented within the QRD, a secure web-based application. Any NCNs identified by the Department require a response within the QRD.

d. Department will provide the Developer access to the Department's QRD application to review and respond to observations made during Department Quality Oversight activities. Developer is required to utilize the Department's QRD application to record all material test quality records, and to respond to Department generated observations. Developer is given the option of either directly entering all PC/IQC observations and material test results into the Department's QRD application or providing Department with data collected during PC/IQC efforts in an electronic format compatible for batch upload into Department's QRD application. Department generated observations will be identified either as conforming or nonconforming to related requirements of the Project Agreement. Department observations will be presented to Developer through Department Quality Oversight Verification Reports. Developer shall be required to respond to all detected instances of Nonconforming Work using Department's QRD application. A construction Nonconformance Report will be closed by Department upon the verification of a resolution of the issue acceptable to Department in accordance with the requirements of the Project Agreement.

6.6.2 Department Construction Verification Tests

The Department will perform periodic verification tests to ensure that the Developer's materials meet the requirements of the Project Agreement. The Department will enter verification test results in the QRD. The Department will perform a statistical analysis to ensure that the Developer's IQC test results correlate statistically with the Department verification test results and meet the requirements of the Project Agreement. If the Department determines that the compared test results do not correlate, the Department will perform Independent Assurance tests to determine the cause of the differences.

6.6.3 Independent Assurance

a. The Department will perform Independent Assurance tests to ensure that:

i. Developer IQC personnel are trained and certified and demonstrate that they understand the test procedures they are performing;

ii. Department verification personnel are trained and certified and demonstrate that they understand the test procedures they are performing;

iii. The test equipment used by the Developer IQC personnel, and Department verification personnel, is calibrated; and

iv. Split sample test results correlate.

b. Independent Assurance test results will also be used as referee tests to assess statistically significant differences, determined by the Department in its sole discretion, between Developer IQC tests and the Department verification test results.

6.6.4 Governmental Authority Inspections

Governmental Authorities shall have the right to inspect the Work, provided that the Governmental Authority has jurisdiction over the Work and as required by applicable law.

6.7 Deliverable Requirements

6.7.1 Quality Management Plan

The Developer shall submit the Stage 1 QMP to the Department for Approval as an NTP1 Condition. The Stage 2 QMP for all remaining Work must have the Department's Approval as an NTP2 Condition. NTP2 will not be issued until the Stage 2 QMP has been Approved by the Department.

6.7.2 Design Deliverables

a. The Developer shall submit to the Department all RFC Documents, revisions to RFC Documents, and As-Built documents.

b. The Developer shall identify on its Project Schedules when the design deliverables identified above will be submitted to the Department.

c. The Developer shall provide two hard copies (11 x17 inches for plans, 8.5 x 11 inches for specifications), and one set of electronic files on DVD of the design deliverables to the Department. As-Built documents shall show all changes. All changes shall be noted using CADD. Hand-drawn changes are not permitted.

d. The design deliverables shall be delivered to the Department indexed and clearly marked to indicate the date of issue and stage of development (e.g., RFC Documents). All design

deliverables shall include a title block, consistent with the standard Work drawing format established as part of the QMP, with the following information:

i. Date of issuance and including all prior revision dates;

ii. Contract title and number;

iii. The names of the Developer, sub-consultants, subcontractors, suppliers, and manufacturers, as applicable; and

iv. Subject identification by Developer drawing or Project Agreement reference.

e. All design deliverables shall be sealed by the Developer's engineer consistent with applicable Legal Requirements. All design deliverables shall include a sufficient blank space, in the lower right corner, just above the title block on the drawings, and in the lower right corner of the title page of specifications and calculations, in which the Developer's engineer may indicate the action taken, indicating his or her review and approval.

f. If a design deliverable requires review approval from a Local Agency or permitting authority, the Developer shall gain such concurrence prior to submitting the design deliverable to the Department.

g. Specifications or CDOT Standard Special Provisions applicable to a design deliverable shall be submitted with the design deliverable.

h. When calculations accompany drawings in a submittal, the body of the calculations shall contain cross-references to the individual drawing to which the pages of the calculations pertain. Calculations required shall demonstrate conformance with the requirements of the Project Agreement.

i. The CADD drawings and associated documents shall be organized in a logical manner, have a uniform and consistent appearance, and clearly depict the intent of the design and construction. In addition:

i. The software requirements for all submitted design deliverables shall be InRoads/MicroStation, in accordance with the current CDOT standards in effect. Project files shall be organized and submitted in accordance with CDOT's ProjectWise format.

ii. The Developer shall prepare As-Builts for the Work that shall include, but not be limited to, the following:

A. Title sheet;

B. Index;

C. Standard Plan List;

D. Roadway design data;

E. General notes;

F. Pavement details;

G. Roadway details;

H. Drainage details;

I. Geotechnical plans;

J. Environmental mitigation, as necessary;

K. Permanent signing plans and sign structure cross-sections;

L. Signalization plans;

M. Aesthetic elements;

N. Roadway typical sections;

O. Roadway geometric layout plans;

P. Roadway geometric layout tables;

Q. Roadway plan;

R. Roadway profile;

S. Detour construction and phasing plans;

T. Detour construction and phasing profiles;

U. Intersection plans;

V. Pavement plans;

W. Drainage plan;

X. Drainage profiles;

Y. Pavement marking plans;

Z. Utility plans;

AA. Right-of-Way plans, for Developer acquisitions;

BB. Right-of-Way monumentation plans;

CC. ITS, ATM, and Tolling plans;

DD. ITS Communication Network plans;

EE. Landscape/seeding plans;

FF. Grading plans;

GG. Lighting plans;

HH. Bridge plans;

II. Wall and shoring plans;

JJ. Roadway cross sections;

KK. ROW plans for Developer acquisitions;

LL. Estimated material quantities;

MM. Other details, as needed; and

NN. Specifications

iii. The Developer shall provide one set each of electronic files on DVD of Utility As-Built documents to the Department and to the respective Utility Owner for Utility Work constructed by the Developer, within 90 Calendar Days after the Utility Owner has accepted the Utility Work. These electronic deliverables shall conform to those requirements set forth in the Project Agreement for CADD requirements, except as modified by the specific requirements of the individual Utility Owners. The Utility As-Built documents shall show locations of existing Utilities, structures, trees, streets, and existing highway ROW limits. Additionally, the Developer shall obtain from each Utility Owner, performing its own Utility Relocations, Utility As-Built documents for such Utility Relocations showing the foregoing information, one set of electronic files on DVD to the Department. The Developer shall show this information on the As-Built documents. All As-Built documents electronic files shall be submitted in MicroStation and *.pdf format.

iv. CADD files shall be in accordance with the appropriate Department standards. All CADD files shall be documented in a tabular format describing the path, file name, and description.

v. The structure of the reference drawings, Contract Drawings, and CADD files are recommended as a guideline for file setup.

6.7.3 Document and Data Approval

The Developer shall ensure that all deliverables include a signed and dated certification by the originator of the deliverables and that the deliverable is complete and meets the requirements of the Project Agreement.

6.7.4 Document and Data Changes

The Developer shall ensure that any changes to deliverables provided to the Department as revised are in a format that can enable changes to be readily apparent and trackable (e.g., documents use the redline/strikeout method).

6.7.5 Product Data

The Developer shall submit to the Department for Acceptance two hard copies of all manufacturers' warranties, guarantees, instruction sheets, parts lists, and other product data within 20 Working Days after installation of the items to which they relate, and in any event prior to Substantial Completion. The Developer shall ensure that the product data cited in this Section is organized and indexed in a manner that allows easy retrieval of information. The Developer shall maintain proper records of product data.

7. SAFETY MANAGEMENT

7.1.1 General

a. The Developer shall be responsible for the establishment, control, direction, and implementation of a comprehensive safety plan that protects the safety of its personnel and the general public affected by the Project. The Developer shall submit to the Department a SMP that is consistent with and expands upon the draft SMP submitted with the Proposal.

b. The SMP shall fully describe the Developer's policies, plans, training programs, Site controls, and incident response plans to ensure the health and safety of personnel involved in the Project and the general public affected by the Project during the Term of the Project Agreement. The SMP shall be approved (signed) by a member of the Developer's executive management, and shall include Work performed by any Subcontractor.

7.1.2 Personnel Requirements

a. The Developer shall provide a Safety Manager with the authority to implement and manage the Developer's SMP. The Safety Manager shall have a high degree of program visibility and shall have authority to perform independent safety evaluations, and to ensure that safety issues are acted on in a timely manner. The minimum experience requirements for the Developer's Safety Manager are a safety professional meeting the following minimum qualifications:

i. Certification as a Safety Professional (CSP) or Certification as an Industrial Hygienist (CIH).

ii. A minimum of five years of progressively responsible construction safety experience specifically related to highway capital development projects.

iii. A minimum of five years of experience in the development of comprehensive safety programs, policies and procedures including the development and implementation of employee safety training programs.

iv. A minimum of five years of experience in occupational safety accident investigation, accident report writing, and OSHA accident reporting.

b. Resume and qualifications summary for the Developer's Safety Manager shall be provided with the SMP.

7.1.3 Submittal

a. The Developer's SMP shall be submitted for Acceptance as an NTP1 Condition and, at a minimum shall include the following:

i. The Developer's commitment and policies on safety and health;

ii. Organizational chart identifying all safety management personnel, roles, authorities, and line reporting relationships. Resumes of key safety management personnel shall be provided;

iii. Developer's approach to educating, training, and communicating to all workers procedures within the SMP. Safety orientation shall be conducted prior to employees entering the Construction Work area;

iv. Procedures for the identification of employees successful completion of safety orientation, and segregation of employees that have not completed safety orientation;

v. Provisions for and the frequency of safety inspections of the Construction Work areas, materials, and equipment to ensure compliance to the SMP, including methods of record keeping and correction of deficiencies;

vi. Provisions for delineation of responsibilities for reporting and investigating accidents, incidents, exposures, and maintaining logs;

vii. Policy for Developer's emergency response, addressing emergency response capabilities and contingency action plans;

viii. Policy on the use of Personal Protective Equipment (PPE) for all Construction Work;

ix. Developer's detailed Construction Safety Critical Plan which shall include an Erection plan, a Bridge Removal Plan, and a Removal of Portion of Bridge Plan, as

applicable, as well as other requirements specified in the Revision of 107 set out in the Project Special Provisions set out in Appendix A to this Schedule 8; and

x. Procedures for immediate notification to the Department of all incidents arising out of or in connection with the performance of the Work, whether on or adjacent to the Project.

b. The SMP is a living document and shall be updated when a process, method, chemical or other Construction Work criteria changes that affects the safety of a person or property. The updated portion of the SMP shall be submitted for Acceptance.

7.1.4 Project staff must be trained on the elements of the Developer's Accepted SMP submittal.

8. DURABILITY PLAN

8.1.1 Sixty (60) Calendar Days after NTP1 the Developer shall submit for the Department's Acceptance a Durability Plan addressing durability for all Residual Elements with a specified minimum Residual Life of forty (40) years or greater. When developing a design deliverable package that involves a Residual Element with a specified minimum Residual Life of 40 years or greater, the Durability Plan for the relevant Elements in the design package shall be updated and submitted with the final plan sets. The Durability Plan shall indicate the durability design basis and the measures in place to ensure the durability requirements are reflected in the final plan sets. Following completion of the final plan sets and prior to Substantial Completion the Durability Plan shall be submitted to the Department for Acceptance to confirm it addresses durability in relation to the completed final plan sets and that the Plan covers the relevant Residual Elements. The Durability Plan shall be updated as necessary based on this review and submitted for final Acceptance.

8.1.2 Following Substantial Completion the Durability Plan shall be reviewed annually by the Developer to ensure that it is consistent with the Maintenance Management Plan and takes account of improvements in industry practice in testing and forecasting Residual Life. Any changes to testing methodologies shall demonstrate a correlation with the superseded methodology so that previous measurements remain relevant to the accurate prediction of the degradation of the relevant Residual Element. The Developer shall make any updates required and submit to the Department for Acceptance.

8.1.3 The Durability Plan shall indicate the maintenance and monitoring strategy, outline the process for establishing the Residual Life in order to fulfill the requirements of Schedule 12 (*Handback Requirements*) for each relevant Residual Element, and shall describe a methodology for the replacement of life expired relevant Residual Elements.

8.1.4 The Durability Plan shall include the following, at a minimum:

a. Identification of each relevant Residual Element with the corresponding environmental exposure conditions for each Element (e.g., buried, submerged, exposed to atmosphere, exposed to corrosive chemicals). Some Elements may be exposed to more than one

environmental condition (e.g., foundations in water table, foundations in areas with petroleum contamination), which might require different corrosion considerations for each exposure.

b. Identification of relevant degradation and protective mechanisms for each structural Element, quantifying the degradation processes and resistances to these processes with respect to time. The time‑related changes in performance for each relevant Residual Element at intervals not exceeding 10 years up to the required service life (including the Handback Work Period). The design life shall be predicted using deterministic models, published industry guidance and test data, allowing for the environmental conditions, and any proposed protective measures. The models and all assumptions shall be clearly indicated in the plan.

c. Description of measures taken during construction to ensure the assumed quality of construction is achieved (e.g., uniform compaction of embankment, adequate concrete cover, proper curing, etc.).

d. Summary of the above information, for each Element, in a tabular format and an estimate of life-cycle costs for the Structure.

e. List of manufacturers of all proposed durability enhancement measures, including coatings, inhibitors, sealers, and membranes.

f. Schedule for corrosion inspection of structural Elements indicating the parameters to be measured in order to confirm the underlying performance relative to that predicted in the design, gathered at intervals of not more than 10 years from Substantial Completion.

g. Proposed maintenance schedule for items/materials that could be affected by corrosion.

8.1.5 Cathodic protection shall not be used to mitigate expected corrosion effects.

8.1.6 For each Structure, the Developer shall prepare an addendum to the Durability Plan indicating the impact of the as-built condition (including Nonconforming Work and testing data) on the predicted design service life and maintenance and inspection regime.

9. MEETINGS

9.1 Task Force Meetings

9.1.1 At a minimum, the Developer shall conduct and take meeting minutes of task force meetings for the following disciplines to facilitate “over the shoulder” review of the design:

a. Drainage;

b. Roadway;

c. Structures;

d. Traffic/ITS/tolling;

e. Maintenance of Traffic;

f. Fire and Life Safety;

g. Cover;

h. Utilities;

i. Right-of-Way;

j. Environmental; and

k. Strategic Communications.

9.1.2 Meeting minutes for each task force shall be provided to the Department within four Working Days following the meeting for Acceptance.

9.2 Safety Meetings

The Developer shall conduct regularly scheduled project safety meetings, tool box talks, etc., as specified in its SMP.

9.3 Quality Meetings

The Developer shall conduct weekly quality meetings with representatives from Quality Control, Quality Assurance, and the Department, in accordance with this Schedule.

10. PHOTOGRAPHS AND VIDEO

10.1 Pre-Construction Photographs and Video

The Developer shall take a sufficient number of pre-construction photographs and a 1080p HD resolution, or greater, video of the Site, including roadways, structures, drainage, and all areas necessary and/or anticipated to be impacted by the Construction Work in HD format so as to resolve any disputes which may arise regarding the conditions prior to and subsequent to construction. Such preconstruction photo and video survey shall be completed prior to the NTP1 and data provided to the Department for Information. If a dispute arises where no or insufficient photographic or video evidence of its existing condition is available, the disputed area shall be restored to the extent directed by the Department at no additional cost to the Department.

10.2 Progress Photographs

10.2.1 At a minimum, the Developer shall take eight megapixel resolution or greater, aerial photographs of the Construction Work and Site every three months. Aerial photographs shall include all areas under construction, whether temporary or permanent, and all other areas impacted, each time

they are taken. One series of oblique photographs shall be taken from one direction along the corridor. The Department's confirmation shall be sought regarding views to be taken and the approximate time at which they will be taken;

10.2.2 The Developer shall provide the Department one complete set of high quality aerial photographs on DVD. The file format shall be .jpg, .gif, or .tiff; and

10.2.3 The Developer shall provide interior and exterior photographs of each buried structure, just prior to burial. Provide a minimum of four internal views (as applicable) and four external views of each structure. Place the following information on the front of digital photographs:

a. Date photograph was taken;

b. Title of Project;

c. Description of view shown in photograph;

d. Identification of photographer; and

e. Sequential number of photograph.

10.3 Time Lapse Photography

The Developer shall provide a continuous time-lapse photo of the viaduct area of the Project from the point of NTP1 to Final Acceptance. Time-lapse camera shall be positioned at a location determined by the Department. Photos shall be uploaded to the Project website in real-time. Resolution shall be 12 megapixels or greater. Camera shall be capable of continuous streaming of data to the web.

11. FACILITIES PROVIDED BY DEVELOPER

11.1.1 The Developer shall provide all office space, equipment, and vehicles as required for the Project. The Developer shall provide space and facilities to allow the Department's staff to co-locate with the Developer's staff. "Co-locate" shall mean located within the same building or office complex.

11.1.2 The Developer shall make available its proposed facilities for inspection and Approval by the Department prior to the Department occupying any Developer provided facilities. Developer shall obtain Approval by the Department no later than 30 Calendar Days after NTP1. Both parties shall participate in a facility condition inspection prior to and at the completion of occupancy. The Department shall return possession of Developer provided facilities to the Developer in the same condition as when the Department initially occupied the facilities, except for reasonable wear and tear.

11.1.3 The Developer shall secure sites, obtain all site Permits, install, set up, and provide Utility services, and maintain the facilities as part of the Construction Work.

11.1.4 In the event that office spaces or appurtenant facilities are stolen, destroyed, or damaged during the Construction Work, the Developer shall at its expense repair or replace those items provided to their original condition within five Working Days, except for any loss or damage caused as a direct result of willful misconduct of Department personnel, which the actual, reasonable, and documented costs of the repair, replacement, and/or restoration will be reimbursed by the Department.

11.1.5 The Developer shall provide office space (the Department offices) and equipment for 40 Department personnel, including at least 10 private offices, specified herein. The Department offices shall meet the BOMO Class B definition for the North Denver Area, similar to the space provided for the US36 project.

a. The proposed facilities shall be located within a one mile radius of the Project. The Developer shall be required to furnish the Department's staff with offices that are in good and serviceable condition (condition comparable to the Developer's office space);

b. The Developer shall maintain the Department offices until at least Final Acceptance unless otherwise agreed to by the Department. The Department may, at its option, vary the number of its staff throughout the duration of the Project. However, the Developer shall maintain the initial number and size of the Department offices, conference rooms, reception area, break room and filing area (the Department Office Facilities) until Final Acceptance following the Construction Period;

c. The Developer shall be responsible for disposal or removal of all the Department office facilities and any site restoration Construction Work required;

d. The Developer shall provide:

i. Telephones and telephone service with at least one outside line for each Department office, reception area, conference rooms, break room, and filing room;

ii. High-speed Internet connection (20 megabyte/sec or greater, synchronous transfer rate business class Ethernet system) and networking for all offices and conference rooms;

iii. A server room (seven feet x 10 feet minimum) for the Department's sole use with supplemental air conditioner if internal air conditioner cannot keep the room (with Department installed server equipment) at or below 75 degrees at all times. This room shall be no further than 300 feet from the farthest cube/office. Electrical in the server room shall consist of two 20-AMP 120V circuits with 2 National Electrical Manufacturers Association (NEMA) 5-15 and 1 NEMA 5-20 outlet on each circuit;

iv. Overhead lighting meeting Occupational Safety & Health Administration (OSHA) and code requirements for office space;

v. Two color laser printer/copiers capable of 45 ppm input and output at 600 x 600 dpi and at least two paper drawers accepting 8-1/2 x 11 inch up to 11 x 17 inch paper and paper weights from 16 to 24 lb. bond, including paper, toner, service and repairs. The unit shall be capable of scanning documents to 11 x 17 inch size and transmitting the scanned file to multiple email addresses; and

vi. Office space not less than the size indicated below:

A. Private offices shall be 150 square feet of enclosed office space (with individual locking door) per office;

B. Partitioned office shall be 100 square feet enclosed office space per office (cubicles/partitions are acceptable);

C. One enclosed conference room with doors capable of accommodating a 30 person meeting, with at least 50 percent of seating capacity at the conference table. This can be a shared conference room between the Developer and the Department, provided that the Department shall be afforded exclusive access during 50 percent of the working hours between 7:00 am and 5:00 pm;

D. One enclosed conference room with doors for the Department's exclusive use capable of accommodating a 20 person meeting, with a 15 person seating capacity at the conference table. The conference room shall be in an adjacent space to the Department Offices;

E. Break room shall be 150 square feet with sink, counter, microwave, and 20 cubic- foot refrigerator, and drinking water and dispenser;

F. Filing space shall be enclosed, with lockable door and 15 steel, five-drawer, locking, lateral file cabinets (approximate size shall be 18 inches by 42 inches). The file room shall also have two 30 x 72-inch utility tables with two chairs each. This space shall be of sufficient size to accommodate the requested equipment and accommodate four staff members (to typical industry standards). This space shall not be shared with any other room;

G. One reception area with common access to the Department Offices; and

H. Storage room: 150 square feet, enclosed with lockable door.

e. Furnishings, as follows:

i. Conference Room

A. Conference table and chairs;

B. Wastebasket; and

C. Hanging, erasable white board that is four feet by six feet minimum.

ii. Offices

A. Desk that is minimum size 76 x 36 inches with locking drawers and keys;

B. Computer workstation desk capable of holding a desktop printer, monitor, keyboard, and any accessories;

C. Worktable (private offices only);

D. Ergonomically correct, OSHA-approved chairs;

E. Extra office chair;

F. Wastebasket;

G. Hanging, erasable white board, minimum three feet by four feet (private offices only); and

H. Bookshelf.

f. Indoor restrooms suitable for number of offices and personnel, including separate facilities for men and women;

g. Hard-surfaced (paved) parking, one space per employee, plus 10 visitor spaces (50 total);

h. Daily janitorial service;

i. Maintenance of the exterior area of office, including access to parking and snow removal;

j. Facilities that meet American with Disabilities Act (ADA) access requirements and meet all local code requirements for office space;

k. Heating, ventilation and air conditioning/cooling systems capable of maintaining an office temperature range of between 68 degrees and 76 degrees (Fahrenheit); and

l. 24 hours a day, seven days a week access with security after normal working hours.

11.1.6 Design-Build Field Laboratory (Owner Verification Testing)

The Developer shall provide two Field Laboratories, Class 2, as per CDOT *M & S Standard Plans*, at a location to be agreed upon by the Department and the Developer. The field Laboratories shall have a minimum of three parking spaces per trailer, all contained within a security fence. The field Laboratories shall be provided to the Department at least 15 Working Days prior to commencement of any field activities involving earthwork of any type, analysis of mix designs, or planned placement of Portland cement concrete pavement (PCCP) or hot

bituminous pavement (HBP) and shall have a forced air oven and high-speed Internet connection.

11.1.7 Project Vehicles

a. The Developer shall, within 30 Calendar Days after NTP1, provide 8- 2015-2016 (110 cu. ft. EPA passenger volume or greater) five-passenger, four-wheel drive, Crossover sport utility vehicles, 4- 2015-2016 (150 cu. ft. EPA passenger volume or greater) seven-passenger, four-wheel drive, Crossover sport utility vehicles, and 8- 2015-2016 four-wheel drive Super Cab (full-size class) pickups, including delivery charges, full service, all applicable taxes, and full coverage insurance, license plate fees, all maintenance, and all other cost inherent to provisions of said vehicles, excluding fuel expense. The vehicles shall be used exclusively by the Department's staff until Final Acceptance;

b. The Project Vehicles shall:

i. Be new, white in color, and complete with all standard equipment;

ii. Comply with the Motor Vehicle Safety Standards, as established by the U.S. Department of Transportation;

iii. Have Developer maintained ownership and title of the vehicles during the period they are in the possession of the Department; and

iv. In case of fire, theft, accident, or breakdown, be repaired or replaced within 48 hours of such occurrence.

c. General equipment for the vehicles shall include:

i. Four Door;

ii. Engine – standard available for each identified model type;

iii. Tires and wheels – standard size for each identified model type, with all season steel-belted radial tires;

iv. Power anti-lock brakes and power steering;

v. Automatic transmissions;

vi. Vinyl floor mats;

vii. Rear window wiper and defroster – electric type (Crossover sport utility type only);

viii. Directional signals with 4-way flasher;

ix. Inside rear view mirror – day/night type;

x. Exterior mirrors – left and right mounted, power adjustable;

xi. Air conditioner/heater;

xii. Radio – AM/FM push-button (minimum);

xiii. Windshield wipers – variable speed with intermittent control; and

xiv. Hood release – inside vehicle.

d. General vehicle light bar shall be as follows:

i. Five-passenger Crossover sport utility vehicles shall be equipped with two amber LEDs on the front grille or one within each headlamp lens, two amber LEDs on the lower portion of the rear liftgate or one within each tail lamp lens, two amber LEDs mounted to the rear portion of the interior headliner and facing to the rear so as to be visible through the rear window, and a full-length light bar (type: Whelen Justice or equivalent) affixed to the roof. The light bar shall be mounted as close to center of the vehicle as practicable but may be mounted rearwards if it is deemed to be more visible. The light bar shall be amber with white work lights to the front, rear, and sides.

ii. Seven-passenger Crossover sport utility vehicles shall be equipped with two amber LEDs on the front grille or one within each headlamp lens, two amber LEDs on the lower portion of the rear liftgate or one within each tail lamp lens, an amber dual LED mounted to the front portion of the interior headliner and visible to the front, an amber dual LED mounted in each rear side window and visible to the sides, and a traffic indicator (type: Whelen Dominator Plus 6 or equivalent) mounted inside the rear window, as high as practicable, so as to be visible to the rear.

iii. Pickup trucks shall be equipped with two amber LEDs on the front grille or one within each headlamp lens, two LEDs within the tail lamp lenses, and a full-length light bar (type: Whelen Justice or equivalent) mounted to the top of the cab, centered approximately between the front and rear axles. Pickup trucks equipped with headache racks shall have the light bar affixed to the top of the headache rack rather than to the cab roof.

iv. Light bars and LEDs shall be programmed to flash amber and white alternately to increase visibility.

e. Vehicle Graphics shall be as follows:

i. All Developer provided Project vehicles shall be equipped with one row of high-visibility reflective chevrons, approximately 4” tall and spanning the width of the vehicle, to be mounted to the rear bumper. If the vehicle is equipped with a split rear bumper, the chevrons may be affixed to the lowest portion of the rear tailgate or liftgate practicable. Adjustments for manufacturer’s logos and body lines are

permitted within reason. Chevrons should be placed with consideration for maximum visibility.

12. PROJECT DIRECTORY

The Developer shall furnish and maintain to the Department a Project Directory listing the names, addresses and telephone numbers (office, home, cellular, etc.) of the Key Personnel and critical support staff of the Developer and each Subcontractor. The Project Directory shall be submitted to the Department, prior to issuance of the NTP1, for Information. The Developer shall update the Project Directory quarterly for the duration of the Construction Work and with any Key Personnel changes.

13. DOCUMENT MANAGEMENT

13.1 General Requirements

13.1.1 The Developer shall establish and maintain its own Document Control System (DCS) to store and record all correspondence, drawings, progress reports, technical reports, specifications, deliverables, calculations, and administrative documents generated under the Project Agreement. The Developer shall also establish correspondence routing, filing, control, and retrieval methods that are compatible with the Department's DCS. Document Control, storage, and retrieval methods shall include the use of both hard copies and electronic records. The Developer's DCS shall handle all documents.

13.1.2 The Department will use Aconex as its DCS, a web-based information management system. Aconex will be the only recognized method for transmittal of formal project correspondence, documents and information (other than for service of legal process). Where it is necessary to transmit original signed documents, these shall be acceptable forms of correspondence only when they have been issued via Aconex first.

13.1.3 The Developer shall use the Department's Aconex system when communicating with the Department. This includes use for all Document Control related documents, transmitting deliverables, and email correspondence purposes for the duration of the Project. The Aconex system will be used by all participants engaged on this Project, including Subcontractors of any tier, Suppliers and their subsequent legal successors in title. It is the Developer's responsibility to ensure consistency with this procedure.

13.1.4 Access to the Department's Aconex system will be provided to the Developer and all Subcontractors free of charge for the duration of the Project.

13.1.5 The Department, at its sole discretion, may elect to use an alternative DCS during the course of the Term. In such case, the Developer shall use this alternative DCS for all correspondence with the Department as described herein.

13.1.6 All correspondence of the Developer to and from the Department and its representatives with respect to the Project shall be categorized and serialized by a method Accepted by the

Department. The Developer shall maintain separate incoming and outgoing correspondence logs. Developer correspondence serialization shall be submitted for Acceptance by the Department prior to NTP1.

13.1.7 The following is the minimum criteria that the Developer's DCS shall provide:

a. Access shall be provided to the Department on a real-time basis that can only be attained through the Internet. The Developer shall maintain industry standards for Internet connectivity as determined by the Department.

b. The Developer's incoming and outgoing correspondence logs shall be available to the Department within 24 hours.

c. Documents within the Developer's DCS must be transferable to the Department's DCS. The transfer of documents shall be performed through the Internet.

d. The Department shall have read only access to the latest set of drawings that are produced during the Construction Period.

e. Process Control (PC) and Independent Quality Control (IQC) data, such as test results, daily inspection records, non-conformance reports, etc., shall be stored by the Developer within their DCS. Real-time access by the Department to PC/IQC data shall be required. PC/IQC data shall be transferred to the Department's DCS on a monthly basis.

14. DELIVERABLES

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the timeframes specified below:

Table 2 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Project Management Plan (PMP)	Acceptance	Prior to the issuance of NTP1, updated annually
WBS	Acceptance	Prior to the issuance of NTP1
Baseline Schedule	Approval	Prior to the issuance of NTP1
Revised Baseline Schedule	Approval	Upon the Department's or Developer's request
Progress Report format	Approval	Within 10 Working Days after NTP1
Progress Report	Acceptance	10 Working Days following prior month's end
Schedule Work Plan	Approval	Prior to the issuance of NTP1
Monthly Progress Schedule	Acceptance	Concurrent with each Progress Report
Maintenance Progress Report	Information	Concurrent with each Progress Report
Record Schedule	Acceptance	Concurrent with final Progress Report
Task Force meeting minutes	Acceptance	Four Working Days following meetings
Developer Provided Facilities	Approval	30 Calendar Days after NTP1
Pre-construction photo and video survey	Information	Prior to the issuance of NTP1
Project Directory	Information	Prior to the issuance of NTP1
Developer DCS correspondence categorization and serialization method	Acceptance	Prior to the issuance of NTP1
Safety Management Plan (SMP)	Acceptance	Prior to the issuance of NTP1
Stage 1 Quality Management Plan (QMP)	Approval	Prior to the issuance of NTP1
Stage 2 Quality Management Plan (QMP)	Approval	Prior to the issuance of NTP2
Durability Plan	Acceptance	60 Calendar Days after NTP1; following completion of final plan sets and prior to Substantial Completion; annually thereafter
Documents for design verification reviews	Acceptance	At least five Working Days before meeting
Other Meeting Minutes (defined in PA)	Acceptance	Four Working Days after meeting
Preliminary (30% level) plan package	Acceptance	As defined in Project Schedules
Task force meeting minutes	Acceptance	Four Working Days after meeting
Design progress review meeting minutes	Acceptance	Four Working Days after meeting

Deliverable	Information, Acceptance, or Approval	Schedule
Quality Manager reports the status of the Work's quality	Information	Monthly
Materials Testing and Inspection Plan (MTIP)	Approval	Concurrent with QMP
Materials Testing and Inspection Plan (MTIP)	Acceptance	Concurrent with RFC Documents
Summary of activity-specific Material quantities	Acceptance	Monthly
Final (100% level) plan sets	Acceptance	As required by Schedule 10
Release for Construction Documents	Acceptance	As required by Schedule 10
Revisions to Release for Construction Documents	Acceptance	As required by Schedule 10
As-Built Documents	Acceptance	As required by Schedule 10
Two hard copies of all manufacturers' warranties, guarantees, instruction sheets, parts lists, and other product data	Acceptance	Within 20 [Calendar][Working]Days after installation of the items to which they relate, and in any event prior to Substantial Completion
COC/CTR log	Acceptance	Prior to Substantial Completion
IQC test measurements and test results	Information	Within 24 hours following inspection or test completion
Weekly look ahead of specific scheduled construction activities	Information	Weekly
Description of actual construction activities conducted during the previous Week	Information	Weekly
Nonconformance Report	Approval	As set out in QMP
Nonconforming Work log	Acceptance	Weekly
Punch List and Punch List log	Acceptance	As required by Part 7 of Schedule 3

15. APPENDICES

Appendix A Project Special Provisions

Appendix A
Project Special Provisions

The following specifications modify and take precedence over the Standard Specifications. The provisions of Appendix A to Schedule 10A Applicable Standards and Specifications apply to these Project Special Provisions.

PROJECT SPECIAL PROVISIONS

REVISION OF SECTION 107
PERFORMANCE OF SAFETY CRITICAL WORK

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

Add subsection 107.061 immediately following subsection 107.06 as follows:

107.061 Performance of Safety Critical Work. The following work elements are considered safety critical work for this project:

(a) Overhead girder erection

(b) Overhead structure construction or repair

(c) Removal of bridge

(d) Removal of portion of bridge

(e) Temporary works: falsework, shoring that exceeds 5 feet in height, cofferdams, and temporary bridges

(f) Work requiring the use of cranes or other heavy lifting equipment to set a girder, to make overhead repairs, or includes special provisions for Removal of Bridge or Removal of Portion of Bridge. Also when construction materials are being lifted that may fall onto active traffic lanes.

(g) Blasting

(h) Excavation and embankment adjacent to the roadway, especially if it requires shoring

(i) Tunneling

(j) Work operations such as pile driving and jack hammering which may create vibration and cause debris to fall into traffic.

(k) Rockfall mitigation

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:

(a) Safety Critical element for which the plan is being prepared and submitted.

(b) Contractor or subcontractor responsible for the plan preparation and the work.

REVISION OF SECTION 107
PERFORMANCE OF SAFETY CRITICAL WORK

(c) Schedule, procedures, equipment, and sequence of operations, that comply with the working hour limitations

(d) Temporary works required: falsework, bracing, shoring, etc.

(e) Additional actions that will be taken to ensure that the work will be performed safely.

(f) Names and qualifications of workers who will be in responsible charge of the work:

1. Years of experience performing similar work
2. Training taken in performing similar work
3. Certifications earned in performing similar work

(g) Names and qualifications of workers operating cranes or other lifting equipment

1. Years of experience performing similar work
2. Training taken in performing similar work
3. Certifications earned in performing similar work

(h) The construction plan shall address how the Contractor will handle contingencies such as:

1. Unplanned events (storms, traffic accidents, etc.)
2. Structural elements that don't fit or line up
3. Work that cannot be completed in time for the roadway to be reopened to traffic
4. Replacement of workers who don't perform the work safely
5. Equipment failure
6. Other potential difficulties inherent in the type of work being performed

(i) 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.

(j) 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.

REVISION OF SECTION 107
PERFORMANCE OF SAFETY CRITICAL WORK

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.

Schedule 9
Submittals

1. Definitions

The following terms have the respective meanings set out below for all purposes of this Schedule 9:

"Deliverable for Acceptance" means any Deliverable that, pursuant to this Agreement, must be submitted either:

(a) for Acceptance; or

(b) for consent, approval or like assent, to the extent that the Department or the Enterprises are, as applicable, pursuant to the express provisions of this Agreement, required to act reasonably in deciding whether to give such consent, approval or like assent.

"Deliverable for Approval" means any Deliverable that, pursuant to this Agreement, must be submitted either:

(a) for Approval; or

(b) for consent, approval or like assent, to the extent such is, pursuant to the express provisions of this Agreement or pursuant to Section 2.2.4.b., in the Department's or the Enterprises' discretion, as applicable.

"Deliverable for Information" means any Deliverable that, pursuant to this Agreement, must be submitted by Developer for Information.

"DRTL" has the meaning given to it in Section 7(a) of this Schedule 9.

"Reviewable Deliverable" means any Deliverable that is a Deliverable for Approval, a Deliverable for Acceptance or a Deliverable for Information.

2. General

The provisions of, and procedures set out in, this Schedule 9 shall govern all Reviewable Deliverables to be submitted either to the Department or the Enterprises pursuant to this Agreement.

3. No Work Prior to Review

Developer shall not commence or perform or take or refrain from taking, and shall ensure that none of its Subcontractors nor any of their respective Subcontractors shall commence or perform or take or refrain from taking, any part of the Work, any relevant obligation or any action to the extent such part, obligation or action is the subject of or governed by, or dependent upon the Approval or Acceptance of, or the provision to the Department or to the Enterprises, as applicable, of an opportunity for review and comment on, a Reviewable Deliverable, until it has submitted the relevant Reviewable Deliverable to the Department or the Enterprises, as applicable, and:

(a) in respect of a Deliverable for Approval:

(i) either the Department or the Enterprises, as applicable, has provided its unconditional Approval of such Reviewable Deliverable; or

(ii) either the Department or the Enterprises, as applicable, has conditionally Approved such Reviewable Deliverable pursuant to Section 6(b)(i)(B) of this Schedule 9, provided that Developer has agreed in writing to comply with or respond to, as applicable, all conditions and comments related to such Reviewable Deliverable;

(b) in respect of a Deliverable for Acceptance:

(i) either the Department or the Enterprises, as applicable, has unconditionally Accepted such Reviewable Deliverable;

(ii) either the Department or the Enterprises, as applicable, has conditionally Accepted such Reviewable Deliverable pursuant to Section 6(b)(ii)(B) of this Schedule 9, provided that Developer has agreed in writing to comply with or respond to, as applicable, all conditions and comments related to such Reviewable Deliverable; or

(iii) if either the Department or the Enterprises, as applicable, has failed to respond to such Reviewable Deliverable within any applicable period determined in accordance with Section 6(a) of this Schedule 9, the Department or the Enterprises, as applicable, subsequently fails to respond within 10 Working Days of receipt of a notice from Developer notifying either the Department or the Enterprises, as applicable, of such failure, in which event the Department or the Enterprises, as applicable, shall therefore be deemed to have Accepted such Reviewable Deliverable;

(c) in respect of a Deliverable for Information, either the Department or the Enterprises, as applicable, has had at least 15 Working Days to review and comment on such Reviewable Deliverable after it was first submitted.

4. **Submission of Deliverables**

(a) Each Reviewable Deliverable submission shall:

(i) include a signed and dated certification by Developer that such Reviewable Deliverable is complete, is suitable for the purpose for which it is submitted and meets the requirements of this Agreement; and

(ii) be accompanied by such supplemental reference information and materials as are reasonably requested by the Department or the Enterprises in advance.

(b) Developer may resubmit any previously submitted Deliverable for Approval or Deliverable for Acceptance, as applicable, that was not previously Approved or Accepted, or otherwise consented to, approved or assented to, without conditions, provided that Developer clearly identifies and documents in its resubmission how all prior conditions and comments have been addressed.

5. **Third Party Review**

If any Reviewable Deliverable requires review or approval from a Governmental Authority, Utility Owner, Railroad or other third Person, Developer shall use Reasonable Efforts to seek and secure such review or approval prior to submitting such Reviewable Deliverable to the Department or the Enterprises, provided that Developer shall concurrently submit to either the Department or the Enterprises, as applicable, any Reviewable Deliverable:

(a) that requires the City of Denver's review or approval pursuant to Exhibit K of the Denver IGA to the Department, the Enterprises and the City of Denver acting in accordance with the terms of the IGA; and

(b) that the Department and the Enterprises otherwise notify Developer likewise requires concurrent review for such review.

6. **Review Process**

(a) Subject to Section 8 of this Schedule 9, the Department or the Enterprises, as applicable, will endeavor to provide Developer with a written response on each Reviewable Deliverable pursuant to Section 6(b) of this Schedule 9 within:

(i) subject to Section 6(a)(ii) of this Schedule 9:

(A) 15 Working Days following an initial submission of such Reviewable Deliverable; and

(B) 10 Working Days of any resubmission of such Reviewable Deliverable, provided that either the Department or the Enterprises, as applicable, may in its or their discretion (and by written notice to Developer) extend such period to 15 Working Days if it or they determine in its or their discretion that such longer review period is necessary; or

(ii) such other period as is otherwise expressly provided for in this Agreement.

(b) The Department or the Enterprises, as applicable, shall provide one of the following responses, in writing, to each Reviewable Deliverable:

(i) for Deliverables for Approval:

(A) unconditional Approval;

(B) conditional Approval, with guidance as to any conditions and/or comments that Developer must agree, in writing, to comply with and/or respond to in order for such conditional Approval to be effective; or

(C) disapproval, with or without guidance as to the basis for the disapproval and/or whether either the Department or the Enterprises, as applicable, expects to subsequently Approve such Reviewable Deliverable following any resubmission subject to modifications and/or conditions (including any that are required to address comments made in the Department's or the Enterprises' response, as applicable);

(ii) for Deliverables for Acceptance:

(A) unconditional Acceptance;

(B) conditional Acceptance, with guidance as to any conditions and/or comments that Developer must agree, in writing, to comply with and/or respond to in order for such conditional Acceptance to be effective; or

(C) rejection, with guidance as to the basis for the rejection and/or whether either the Department or the Enterprises, as applicable, expects to subsequently Accept such Reviewable Deliverable following any resubmission subject to modifications and/or conditions (including any that are required to address comments made in the Department's or the Enterprises' response, as applicable);

(iii) for Deliverables for Information, comments or written confirmation of "no comments".

(c) Notwithstanding any Approval, Acceptance, comment or other response of or on a Reviewable Deliverable, Developer acknowledges and agrees that its ability to rely on the same is subject to Section 2.2.5.

7. **Tracking of Deliverables**

(a) Prior to NTP1, Developer shall submit to the Department for Acceptance the Deliverable Requirements Tracking List ("DRTL"). The DRTL shall (i) identify each Reviewable Deliverable and (ii) specify the type of Reviewable Deliverable. The DRTL shall include Developer's proposed timeframe and sequence for submission, review and resolution of each Reviewable Deliverable and show how, given the proposed timing and sequencing of such Reviewable Deliverables, the Department or the Enterprises shall be able to reasonably review and respond to all such Reviewable Deliverables pursuant to Section 6 of this Schedule 9 while avoiding the concurrent review of two or more Reviewable Deliverables that require review by the same specialty experts (as reasonably determined by the Department or the Enterprises, as applicable) unless the Department has previously Approved such concurrent review.

(b) Following the Department's Acceptance of the DRTL, Developer shall use the DRTL to track the status of all Reviewable Deliverables, including all submissions and resubmissions and responses from the Department and the Enterprises, as applicable. Developer shall deliver to the Department for Acceptance monthly updates to the DRTL to track the status of all Reviewable Deliverables.

8. **Sequencing**

(a) Developer shall use Reasonable Efforts to schedule, prioritize and coordinate all Reviewable Deliverables to allow an efficient and orderly Reviewable Deliverables review process pursuant to this Schedule 9 and the DRTL. To the extent that Developer exceeds any of the limits on Reviewable Deliverables set out in this Agreement or the DRTL, the Department shall (acting reasonably and taking into account the number and nature of any other Reviewable Deliverables that the Department and/or the Enterprises may concurrently be in the process of reviewing) determine a time period for the review by it or by the Enterprises, as applicable, of the Reviewable Deliverables that exceed such limit.

(b) For certainty, neither the Department nor the Enterprises shall be obligated to concurrently review two or more Reviewable Deliverables that require review by the same specialty experts (as reasonably determined by the Department or the Enterprises, as applicable) unless the Department has previously Approved such concurrent review.

9. **Developer Responses**

Developer shall respond to all of the comments and responses from the Department or the Enterprises (other than responses reflecting unconditional Approval or Acceptance) on or to a Reviewable Deliverable and, except with respect to Deliverables for Information (where any response is in Developer's discretion), make modifications to such Reviewable Deliverable as necessary to fully reflect and resolve all such comments and responses and then, to the extent required by the provisions of this Agreement, resubmit any Reviewable Deliverable for Approval or Deliverable for Acceptance as many times as is necessary until either the Department or the Enterprises, as applicable, has Approved or unconditionally Accepted, as applicable, the relevant Reviewable Deliverable.

1. GENERAL

1.1 Purpose

1.1.1 The purpose of this Section is to summarize the Developer's obligations with respect to design and construction of the Project by identifying major elements of the Construction Work, including references to the processes and procedures that the Developer is required to comply with.

1.1.2 Reference is made to the Sections of this Schedule and other Schedules which include details of the specific requirements relevant to the Construction Work.

1.2 Application of Schedule 10 Design and Construction Requirements

1.2.1 Without limiting any other provision of this Project Agreement, this Schedule (including all of the terms, conditions, requirements, criteria, specifications and standards set out or referenced herein) comprises the minimum obligations of the Developer in respect of the matters set out in this Schedule, including in respect of the provision, performance and carrying out of the Construction Work.

1.2.2 The Developer shall ensure that the Construction Work complies with and is undertaken in accordance with the terms, conditions, requirements, criteria, specifications and standards set out or referenced in this Schedule.

1.2.3 In complying with the terms, conditions, requirements, criteria, specifications and standards set out or referenced in this Schedule, the Developer shall give due regard to the terms, conditions, requirements, criteria, specifications and standards set out or referenced in each of the other Sections of this Schedule and to the other provisions of the Project Agreement.

1.2.4 Nothing in any one Section of this Schedule shall relieve the Developer from its obligations to comply with the terms and conditions, requirements, criteria, specifications and standards set out or referenced in each of the other Sections of this Schedule.

1.2.5 The Developer shall design and construct all Elements of the Project in compliance with the requirements of all relevant Sections of the Project Agreement including all performance requirements and the Handback Requirements.

1.3 General Requirements

The Developer's obligations in respect of the Construction Work are summarized below and shall be carried out in accordance with the Project Agreement, the Sections of this Schedule and other Schedules:

a. Removal and replacement of the existing I-70 Mainline on viaduct from Brighton Boulevard to Colorado Boulevard, with the I-70 Mainline lowered below existing grade;

b. Construction of Cover over the I-70 Mainline between Columbine Street and Clayton Street;

c. Reconstruction of the I-70 Mainline from Brighton Boulevard to Quebec Street;

d. Widening of the I-70 Mainline to include a Tolled Express Lane in each direction from Quebec Street to Chambers Road;

e. Restriping of the existing I-70 Mainline from east of I-25 to Brighton Boulevard;

f. Construction of cross streets at Brighton Boulevard, York Street, Josephine Street, Columbine Street, Clayton Street, Fillmore Street, Steele Street/Vasquez Boulevard, Cook Street, Monroe Street, Colorado Boulevard, Dahlia Street, Holly Street, Monaco Street, Quebec Street, Central Park Boulevard, Havana Street, Peoria Street and Chambers Road;

g. Combining existing ramps at Dahlia Street and Monaco Street into a single interchange at Holly Street;

h. Reconstruction of the UPRR Crossing, BNSF Crossing, and DRIRR Crossing;

i. Reconstruction of the I-270 eastbound bridge over I-70 Mainline;

j. Provision of ITS and ETC system infrastructure, including an Active Traffic Management system; and

k. Maintenance of traffic including maintenance of existing roadways, including detours, during the Construction Period.

1.4 Notices to Proceed (Schedule 3)

Parts 1 and 2 of Schedule 3 shall apply in respect of the commencement of the Construction Work.

1.5 Project Administration (Schedule 8)

The Developer shall comply with its obligations under Schedule 8 Project Administration and undertake all actions as necessary when discharging its obligations relating to project management and Quality Assurance Activities for the Construction Work.

1.6 Deliverables (Schedule 9)

The Developer shall comply with the procedures set out in Schedule 9 Submittals when making submittals to the Department in connection with the Construction Work.

1.7 Approvals, Consents and Permits

Except to the extent expressly provided otherwise in the Project Agreement, the Developer shall be responsible for obtaining all Governmental Approvals and Permits in connection with the Construction Work.

1.8 Detailed Requirements

Detailed requirements for individual Construction Work elements are described in the remaining Sections of this Schedule listed below:

a. Section 2: Maintenance of Traffic;

b. Section 3: ITS and Tolling Equipment;

c. Section 4: Utilities;

d. Section 5: Survey;

e. Section 6: Roadway Pavements;

f. Section 7: Earthwork;

g. Section 8: Drainage;

h. Section 9: Roadway;

i. Section 10: Railroads;

j. Section 11: Signing, Pavement Markings, Signalization and Lighting;

k. Section 12: Cover MEP System;

l. Section 13: Structures; and

m. Section 14: Landscaping and Aesthetics

1.9 Applicable Standards and Specifications (Schedule 10A)

1.9.1 Except to the extent expressly provided otherwise in this Project Agreement, the Developer shall design and construct the Project in accordance with the Construction Standards. The list of standards in Schedule 10A Applicable Standards and Specifications shall not be considered comprehensive.

1.9.2 The I-70 Mainline and CDOT Roadways and associated Construction Work shall be designed and constructed in accordance with CDOT *Standards and Specifications* (as modified by Appendix A to Schedule 10A Applicable Standards and Specifications).

1.9.3 Local Agency Roadways and associated Construction Work shall be designed and constructed in accordance with the standards and specifications of the Local Agency (e.g., City and County of Denver).

1.10 Contract Drawings (Schedule 10B)

Schedule 10B Contract Drawings contains the Contract Drawings in accordance with which the Developer shall develop the design and construct the Project.

1.11 Reference Documents (Schedule 29)

Section 3 sets out the status of the Reference Documents in relation to the performance of the Work, including the Construction Work.

1.12 Strategic Communications (Schedule 14)

The Developer shall comply with its obligations under Schedule 14 Strategic Communications when discharging its obligations relating to Construction Work.

1.13 Environmental Requirements (Schedule 17)

Except to the extent expressly provided otherwise in the Project Agreement, the Construction Work required to be carried out by the Developer:

a. Shall include all Elements and commitments described in the I-70 East EIS to the extent that such Elements and commitments relate to the scope of the Project;

b. Shall be compatible with the I-70 East EIS to ensure implementation of the Ultimate configuration to the extent that it relates to the scope of the Project; and

c. Shall include all mitigation measures required to be carried out to ensure compliance with the I-70 East EIS, as required by Schedule 17 Environmental Requirements.

1.14 Right-of-Way (Schedule 18)

Right-of-Way defines a major constraint to the Developer's design in terms of boundary restrictions and limits of the Construction Work. Except to the extent expressly provided otherwise in this Project Agreement, the obligations and responsibilities of the Department and the Developer are set out in Schedule 18 Right-of-Way and the Parties shall comply with these accordingly.

1.15 Havana Street Design-Build Project

A separate improvement project, the Havana Street Design-Build Project, involves construction of the I-70 Mainline to the Ultimate configuration. The improvements are planned to be completed prior to issuance of NTP 2. The Developer's Construction Work within the physical limits of the Havana Street Design-Build Project shall include any striping, signing or other modifications required to accommodate the Construction Work.

1.16 City and County of Denver Identified Future Improvements

The Developer's design and construction shall not preclude City and County of Denver identified improvements including:

a. Construction of a future second cover over the I-70 Mainline from west of Steele/Vasquez to east of Cook Street;

b. Construction of a pedestrian overpass over the UPRR Crossing along 47th Avenue;

c. Conversion of York Street to two-way operations;

d. Conversion of Josephine Street bridge over the I-70 Mainline to a pedestrian crossing; and

e. Widening of Quebec Street by one additional lane northbound and southbound, assume the widening of existing roadway both east and west.

2. MAINTENANCE OF TRAFFIC

2.1 General

The Developer shall be responsible for designing, providing and maintaining safe and effective traffic control on all roadways that are affected by the Construction Work for the movement of people, goods, and services through and around the Project while minimizing impacts to local residents, businesses and commuters.

2.2 Transportation Management Plan

2.2.1 The Developer shall prepare a Transportation Management Plan (TMP) including Temporary Traffic Control Plan (TCP) Strategies, a Transportation Operations (TOP) Strategies, and Public Information (PI) Strategies for all proposed Work associated with the Project during the Construction Period. Responsibilities include monitoring and updating the TMP throughout the Construction Period. The TMP shall document how traffic shall be managed during the construction of the Project. The TMP shall follow the requirements shown in CDOT's *Work Zone Safety and Mobility Rule Procedures Document*.

2.2.2 Submission by the Developer, and Approval by the Department, of the TMP shall be prior to the issuance of NTP 2. Subsequent modifications to the TMP shall be submitted to the Department for Approval.

2.2.3 Transportation Management Plan Content

The Developer shall prepare a TMP that defines the strategic plan for traffic management on the Project. The TMP shall address major aspects of the Construction Work for individual construction areas, phases, and stages. The Developer shall involve all affected agencies in the development of the TMP and associated plans. The TMP shall be used as a planning and policy guide to develop and execute the Maintenance of Traffic (MOT) program for the Project. The TMP's contents shall include at a minimum the following:

a. An overview and description of the Project, subdivided as applicable, into the following components:

   i. Area: A specific grouping of Construction Work for the Project, defined by the Developer, which creates segments of the Project for the purpose of planning and executing the Construction Work;

   ii. Phase: A specific sequence of the Construction Work in an area during which a major traffic movement is undertaken (e.g., a detour) and left in place until the Construction Work is complete and traffic is redirected to another location. This shall require development of a specific TCP. In some cases, multiple TCPs may be necessary; and

   iii. Stage: A subdivision of Construction Work within a phase that combines similar components of Construction Work to maintain efficiency.

b. Provide information on existing and future conditions including traffic, safety, and business/community access.

c. A list of known or potential roadway, ramp, and lane Closures, including the following information:

   i. Description of traffic shift;

   ii. Description of detour:

      A. Identification of detour limits to be used in each construction phase; and

      B. Developers' identification and coordination with other construction projects, within the vicinity of the proposed detour route. The impact of these

construction projects shall be incorporated into the detour route planning and scheduling.

iii. Number of shifts expected; and

iv. Duration of shifts and detours.

d. A description of proposed detour routes;

e. Typical section requirements;

f. Emergency requirements:

i. Pull-out locations;

ii. Emergency access; and

iii. Courtesy patrol.

g. Temporary Closure scenarios:

i. Location; and

ii. Time and duration.

h. Access:

i. Pedestrian/bike;

ii. Business;

iii. Project; and

iv. Bus/transit.

2.2.4 Temporary Traffic Control Plan Strategies

a. The Developer shall provide a detailed approach to the development of TCPs and Methods of Handling Traffic (MHT) on the Project;

b. Business and Private Access

The Developer shall maintain public and private access to the local street system. See additional requirements under the Maintenance of Access Plan included in this Section. TCPs and MHTs shall incorporate stakeholder information from the PI, available surveys, and other pertinent studies relating to business and private access to the local street system and the highway facilities. At a minimum, the Developer shall communicate and document the following information relevant to business and private access:

i. Access points impacted by a particular construction phase or stage;

ii. All notifications of affected businesses and land owners;

iii. Schedule of Closures and estimated durations;

iv. Project-specific access or delivery requirements for local businesses (deliveries, wide load vehicles, etc.); and

v. Proposed mitigation efforts.

c. Colorado Transportation Management Center Coordination

i. The Developer shall provide an approach to the use of Intelligent Transportation System (ITS)/Variable Message Sign (VMS) boards and traffic signals/ramp meter stations, including coordination with the Denver Traffic Management Center, and Colorado Transportation Management Center (CTMC);

ii. Routine requests for use of the CTMC VMS boards shall be submitted to the Department by 10:30 a.m. on Thursday of the week prior to when the VMS boards

will be needed (Monday through Sunday of the following week). Requests for routine use of the VMS will be reviewed by noon Friday of the same week of the submittal. The Developer shall coordinate directly with the CTMC at 303-512-5830 following review by the Department;

iii. For after-hours (non-construction work times) operations only, the Developer shall coordinate directly with the CTMC. The CTMC is available to the Developer to modify VMS messages 24 hours a day, seven days a week; and

iv. The Developer shall coordinate with the Colorado Department of Transportation (CDOT), City and County of Denver (CCD), and the CTMC in relation to Emergencies, in accordance with the Accepted Incident Management Plan (IMP).

2.2.5 Transportation Operations Strategies

The Developer shall:

a. Provide a detailed approach to Travel Demand Management (TDM) strategies;

b. Inventory existing bus routes/stops and provide an approach to coordination with Regional Transportation District (RTD) to resolve disruptions in services due to the Construction Work;

c. Provide an approach to traffic access management, including restrictions, bicycles, pedestrians, and potential impacts to handicapped mobility;

d. Provide an approach to coordinate with Denver International Airport during peak travel times;

e. Provide an approach to pedestrian movements associated with Swansea Elementary school access. Coordinate with Swansea Elementary School as specified in Schedule 14 Strategic Communications and to specifically provide Safe Routes to School, considering sidewalks, crossing guards, bus shuttles, signing, pavement markings, pedestrian signalization. Specifically address pedestrian movements at the York Street/Union Pacific Railroad at-grade crossing.

f. Develop a detailed IMP to manage traffic incidents and emergency operations on the Project. The IMP shall comply with the CDOT *Guidelines for Developing Traffic Incident Management Plans for Work Zones*. The IMP shall be submitted to the Department for Acceptance within 30 Calendar Days after the issuance NTP 1. At a minimum, the IMP shall include the following:

i. Coordination with the PIP;

ii. Incident detection and identification;

iii. Incident response;

iv. Incident site management;

v. Incident clearance;

vi. Dissemination of traveler information regarding incidents;

vii. Courtesy patrol;

viii. Emergency Services notification, including local area police departments, the Colorado State Patrol (CSP), local area fire departments, ambulance services, and any other Emergency response providers;

ix. Notification of local school districts about possible impacts to school bus routes, student drop-offs, and/or pedestrian facilities;

x. Geographic and other special constraints;

xi. Available resources; and

xii. Operational procedures.

g. The Developer shall develop and implement a TDM program to reduce travel demand and improve traffic operating conditions during the Construction Period. The Travel Demand Model program shall specify:

i. A TDM marketing plan (i.e. park and ride promotion, incentives, etc.);

ii. A plan to evaluate the effectiveness of the TDM program; and

iii. TDM strategies which would complement current corridor and regional strategies.

iv. TDM strategies, Approved as part of the TMP, shall be implemented within 30 Calendar Days following the issuance of NTP 2.

2.2.6 Public Information Strategies

a. Provide a detailed approach to coordinate the TMP Activities with performance of the Developer's obligations under Schedule 14 Strategic Communications;

b. A checklist identifying specific items shall be provided to the Department by the Developer's Project Communications Manager;

c. The Developer's Project Communications Manager and the Department's Communications Manager shall meet once per week to discuss public information and management Activities on the Project. The checklist shall provide the inclusion of supporting information relevant to coping messages and public awareness and shall be included in the Construction Work Communications Plan (CWCP), as described in Schedule 14 Strategic Communications;

d. The Developer shall establish a MOT Task Force to ensure proper coordination with affected agencies. The MOT Task Force shall include, at a minimum, the Developer's Public Information Officer, Traffic Control Supervisor, Superintendent, the Department, RTD, and Local Agencies (e.g., CCD, Commerce City, and City of Aurora). The Developer shall submit the proposed list of the MOT Task Force members to the Department for Acceptance within 30 Calendar Days after issuance of NTP 1. Within 14 Calendar Days after Acceptance of the proposed list of MOT Task Force members, the Developer shall convene a TMP kick-off meeting. The meeting will be used to develop agreement upon the level of detail required for the TMP; and

e. The MOT Task Force shall meet weekly, and shall be an integrated component of the CWCP, as described in Schedule 14 Strategic Communications. The Developer is responsible for the preparation and distribution of agendas, meeting materials, and meeting minutes and shall submit the minutes to the Department, for Acceptance.

2.3 Maintenance of Traffic Variance Process

2.3.1 The Developer shall adhere to the requirements for lane Closures, detours and any other restrictions as set forth within this Section 2, except the Developer may request an MOT Variance from the Department or, as the case may be, the relevant Local Agency to reduce neighborhood/business impacts, improve safety, or improve quality.

2.3.2 In relation to MOT Variances required from the Department, if the Developer can show some benefit in the areas referred to in Section 2.3.1 above, and present it successfully to the Department, then the Developer may be granted an MOT Variance. The following information shall be included in each MOT Variance request submitted to the Department:

a. Summary of the MOT Variance request;

b. Justification for the MOT Variance request, including a list of the criteria that cannot be met and the reasons for not being able to meet the criteria;

c. Public notification methods and schedule;

d. List of affected Emergency Services and the schedule for notification;

e. List of affected Local Agencies or private owners and the method(s) and schedule for notification;

f. Description of additional public information surveys to be performed, if required;

g. List of any potential safety hazards to which the public may be exposed;

h. Proposed revisions to the Accepted TCP or current MHT; and

i. Proposed duration of lane Closure, detour, or phasing change for which a MOT Variance is requested.

The Developer shall submit any MOT Variance request to the Department for Approval 30 Calendar Days prior to implementation.

2.3.3 In relation to MOT Variances required from a Local Agency, the Developer shall comply with all Local Agency requirements, including submittal contents and time periods, relating thereto. In addition, the Developer shall meet all Local Agency requirements for detours utilizing non-State owned facilities. Promptly after receipt of the relevant approval, the Developer shall submit a copy of any approved MOT Variance granted by a Local Agency to the Department for Information.

2.4 Developer Response Time

The Developer shall have at least one employee on call at all times, via cellular phone, that can be a point of contact for immediate response to an incident (i.e. within 30 minutes or less after notification). Upon arrival at the incident, Developer shall assess the situation and immediately notify the appropriate personnel to implement the IMP. Upon notification of the incident, the Developer shall cooperate with the Emergency Services and immediately undertake actions necessary to restore traffic operations, as described in the IMP, in a timely and expedient manner.

2.5 Special Events

2.5.1 The Developer shall coordinate with the Department's Communications Manager and the Local Agencies to develop a list and schedule of Special Events. The Developer shall update the list as events are identified/scheduled. The special event calendar shall be a standing agenda item at the MOT Task Force meetings.

2.5.2 The Developer shall coordinate with the CCD and other Local Agencies to develop mitigation that the Construction Work creates regarding delays before, during and after Special Events. This shall include and will not be limited to events such as dignitary escorts, sporting facilities, the National Western Stock Show, Dicks Sporting Goods Park, Pepsi Center, Sports Authority Field, Taste of Colorado, local races, local runs, parades, etc.

2.5.3 The Developer shall identify and implement necessary changes in Construction Work Activities to accommodate traffic to and from Special Events. No lane Closures shall be permitted on the day of any Special Event unless Approved by the Department 14 Calendar Days prior to implementation. Construction Work outside the travel lanes, ramps and shoulders shall be permitted during Special Events unless specifically prohibited otherwise in this Section.

2.6 National Western Stock Show

The Developer shall identify and implement necessary changes in Construction Work progress to accommodate traffic to and from the National Western Stock Show. No Construction Work is permitted at the Brighton Boulevard Interchange, ramps or any other local streets that could affect traffic movements to and from the National Western Stock Show. No lane Closures shall be permitted for the duration of the National Western Stock Show. Additionally, Construction Work outside the travel lanes, ramps and shoulders at restricted locations shall not be permitted.

2.7 RTD Transit System

2.7.1 The Developer shall coordinate with RTD to minimize any impacts to the RTD transit system as a result of the Construction Work, including bus routes, station access, bus stop locations, and other RTD services.

2.7.2 The Developer shall maintain access to all RTD stations within the Project during construction. Any modifications to RTD station access or bus stop locations shall be submitted to the RTD for approval and copied to the Department, for Information.

2.8 Coordination with Adjacent Projects

The Developer shall coordinate with the Department, RTD, Local Agencies, and adjacent projects to coordinate construction traffic and detour impacts and minimize simultaneous lane Closures or impacts to adjacent or alternate routes.

2.9 Maintenance of Access Plan

The Developer shall maintain a minimum of one driveway per business at all times. If a business has delivery driveways or access, the Developer shall also maintain a minimum of one delivery access. For businesses with multiple driveways, when driveway Closure is necessary to progress Construction Work, no driveway may be closed for more than 30 consecutive Calendar Days or more than 45 Calendar Days in aggregate. The grades for temporary driveways shall not be greater than the existing driveway grade.

2.10 Maintenance of Traffic Analysis and Operations

2.10.1 The Developer shall evaluate intersection traffic operations in advance of all major MOT phases. Major phases will be identified at the discretion of the Department, and will generally be indicated by major changes in Construction Work locations and lane Closures. The purpose of the evaluation is to ensure that any traffic operations impacts related to the MOT Plans are acceptable to the Department and the Local Agencies. The Developer shall use existing traffic data supplied by the Department, supplemented by additional traffic counts by the Developer as required. The Developer shall report any increases in intersection delay or queue length. The Developer shall use the traffic modeling software, provided in the Reference Documents, to project the expected queue lengths and delays.

2.10.2 The Department will not use specific delay or queue length thresholds for evaluation, but traffic operations will be evaluated while considering the Developer's overall MOT Plans and approach. The Developer shall be responsible for monitoring actual queues and delays during MOT operations. If the queues and delays exceed the predicted value (regardless of the reason), then it shall be the Developer's responsibility to modify the TCPs to mitigate impacts to traffic operations. All proposed changes to the TCPs shall be submitted to the Department for Acceptance.

2.10.3 The Developer shall submit the MOT operations and analysis to the Department for Acceptance. The traffic analysis shall be summarized in report format, and include all supporting documentation.

2.10.4 The Department may identify that additional analysis is necessary if the traffic impacts are unacceptable to the Department. If so, the Developer shall be required to prepare an analysis of the Construction Work Activities that includes the following:

a. Project Location and Description:

i. Location and Construction Work required;

ii. Existing condition;

iii. Purpose for the threshold exception request, along with how long and what hours the lane Closures will be in effect; and

iv. Recommendations to minimize impacts.

b. MOT Alternatives

i. All potential options for MOT with descriptions and discussions of each, including the following:

ii. Advantages/disadvantages;

iii. Estimated timeframe;

iv. Potential economic impact to communities and businesses; and

v. Ability to gain public buy-in and awareness of the impacts and means to mitigate those impacts.

c. Traffic Analysis

i. Queue/delay analysis;

ii. Percent diversion that is reasonable to expect given the location and construction Activity; and

iii. Resulting traffic operations after diverting.

d. Detour Calculations

i. If a detour is proposed, provide detour route description, detour map(s), and user cost created to travel the extra distance;

ii. Provide capacity, volume, and queue length calculations for the critical node along the detour route; and

iii. Suggest improvements to the detour route to improve traffic flow on the route with the detour traffic.

e. Summary and Recommendations

i. List alternatives in order of preference and explain why the alternative is or is not preferred; and

ii. Summarize alternatives in table format, including important comparison items such as maximum queue lengths; the number and width of open lanes; the length, dates, and duration of construction period for the relevant part of the Construction Work.

2.11 Design Requirements

2.11.1 The Developer's Professional Engineer in responsible charge of the MOT design shall prepare or oversee, review, seal with a Colorado PE stamp and approve: field design changes; Release for Construction Documents; and TCP and MHT plans.

2.11.2 Temporary Traffic Control Plan

a. The Developer shall prepare a TCP to control traffic on the Project. The TCP shall conform to the requirements specified herein and the CDOT *Standard Specifications*. The TCP shall generally describe all lane and shoulder configurations, including widths, traffic control signing, pavement markings, traffic control devices, temporary signalization, construction access, construction parking, emergency access, work areas, and pedestrian/bicycle requirements necessary for each construction phase. Temporary traffic signals shall be installed as described in Schedule 10, Section 11 Signing, Pavement Marking, Signalization, and Lighting;

b. The TCP shall be submitted to the Department for Acceptance; and

c. Any major revision to the TCP, as determined by the Department, shall require submission of a new TCP for Acceptance.

2.11.3 Method of Handling Traffic

The MHT shall be submitted to the Department for Acceptance.

2.11.4 Detour Design

Detour design shall be as described in Table 2-1.

Table 2-1 Design and Posted Speeds for Construction Work Zones

Location	Design Speed (mph)	Posted Speed (mph)
I-70 Mainline	60	55
Ramps and collector-distributor roads	As posted under existing conditions	As posted under existing conditions
CDOT Roadways and Local Agency Roadways	As posted under existing conditions	As posted under existing conditions

2.11.5 Full Roadway Closure Restrictions

Local Agency Roadways will be affected by the reconstruction of I-70 Mainline between Brighton Boulevard and Quebec Street requiring restrictions regarding concurrent Construction Work Activities as follows:

a. North and South Connectivity and Roadway Restrictions

i. Maintaining access to the Elyria and Swansea Neighborhoods and to reducing out of direction travel is critical, therefore concurrent roadway Closures for northerly/southerly crossings over the I-70 Mainline are not permitted. In addition, the businesses, schools and social gathering spots in these communities depend on the crossings to traverse the neighborhood, and provide as little disruption to their livelihood as possible. Construction phasing shall be taken into account in the determination and implementation of construction phasing and detours. All directions of travel during construction phasing shall be considered in the roadway network to maintain current circulation and prevent the isolation of communities, especially north and south of the I-70 Mainline; and

ii. Roadway Closures for north-south facilities shall be in accordance with Table 2-2. The Construction Work restrictions, as shown in the table, show where concurrent Closures are not permitted.

Table 2-2 Concurrent Full Roadway Closure Restrictions for North-South Facilities

		Roadway Closures Not Permitted																			
		Brighton Boulevard	UPRR Crossing	York Street	Josephine Street	Columbine Street	Clayton Street	Fillmore Street	Steel Street\ Vasquez Boulevard	Cook Street	BNSF Crossing	Monroe Street	Colorado Boulevard	Dahlia Street	Holly Street	Monaco Street	Quebec Street	I-70 Slip Ramp WB at Monaco Street	I-70 Slip Ramp EB at Dahlia Street	I-70 Slip Ramp WB at Dahlia Street	I-70 Slip Ramp EB at Monroe Street
Active Construction Work	Brighton Boulevard	-		X	X				X												
	UPRR Crossing		-																		
	York Street	X		-	X	X															
	Josephine Street	X		X	-	X															
	Columbine Street			X	X	-	X														
	Clayton Street					X	-	X													
	Fillmore Street						X	-	X												
	Steele Street/ Vasquez Boulevard	X						X	-			X	X								
	Cook Street									-											
	BNSF Crossing										-										
	Monroe Street								X			-	X								
	Colorado Boulevard								X			X	-	X			X				
	Dahlia Street												X	-	X						
	Holly Street													X	-	X		X	X	X	X
	Monaco Street														X	-	X				
	Quebec Street												X			X	-				

X means Closure is not permitted

For certainty, for purposes of the definition of Construction Closure Deduction:

I. paragraph a. of such definition shall apply to any full roadway Closure not permitted by the final four columns of Table 2-2; and

II. paragraph b. of such definition shall apply to any full roadway Closure not permitted by any other column of Table 2-2.

b. East and West Connectivity and Roadway Restrictions

i. 46th Avenue North between Brighton Boulevard and Colorado Boulevard shall be open prior to the closing of the existing 46th Avenue for the removal of the existing viaduct; and

ii. Stapleton Drive, between Colorado Boulevard and Oneida Street, shall maintain a minimum of one lane in each direction, for access to businesses. In single lane situations, a minimum lane width shall be 16 feet.

2.11.6 Swansea Elementary School

Maintaining safe and effective operations for the Swansea Elementary School shall be accounted for in the development of the construction phasing. Columbine Street and Clayton Street are essential roadways for access to the school and shall not be closed while school is in session. The Developer shall coordinate with Denver Public Schools for all Closures and operational impacts in the area of the School. The Developer's TMP shall include Safe Routes to School solutions; meeting the requirements included in the Safe Routes to School Online Guide located at http://guide.saferoutesinfo.org/.

2.11.7 Offsite and Onsite Outfall Systems

For the construction of the Offsite Outfall System and the Onsite Outfall System, the Developer shall coordinate the construction phasing and traffic control plans with CCD, local business owners, Railroads and other Persons, as required. The Developer is responsible for obtaining required Local Agency approvals and Permits prior to submittal of TCPs to the Department for these Elements of the Construction Work.

2.11.8 Permitted Freeway Lane Closure Hours

a. I-70 permitted lane Closure hours

Tables 2-3 and 2-4 below set out the times when the Developer shall be permitted to implement lane Closures on I-70 Mainline during the Construction Period, provided that, for certainty, no such lane Closures are permitted on a Holiday.

Table 2-3 Single Lane Closures on the I-70 Mainline from Pecos Street to Airport Boulevard

Pecos Street to Airport Boulevard (MM 273 to MP 284.627)				
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Weekday**	**Weekend**
270.496 (Sheridan Blvd)	274.000 (I-25)	EB	7 PM to Midnight Midnight to 5:30 AM	7 PM to Midnight Midnight to 9 AM
274.000 (I-25)	270.496 (Sheridan Blvd)	WB	7 PM to Midnight Midnight to 5:30 AM	7 PM to Midnight Midnight to 9 AM
274.000 (I-25)	276.572 (SH 2)	EB	8 PM to Midnight Midnight to 5 AM	8 PM to Midnight Midnight to 8 AM
276.572 (SH 2)	274.000 (I-25)	WB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 8 AM
276.572 (SH 2)	282.563 (I-225)	EB	7 PM to Midnight Midnight to 5:30 AM	7 PM to Midnight Midnight to 9 AM
282.563 (I-225)	276.572 (SH 2)	WB	7 PM to Midnight Midnight to 5:30 AM	7 PM to Midnight Midnight to 9 AM
282.563 (I-225)	285.727 (Tower Rd)	EB	10 PM to Midnight Midnight to 5 AM	11 PM to Midnight Midnight to 6 AM
285.727 (Tower Rd)	282.563 (I-225)	WB	10 PM to Midnight Midnight to 5 AM	11 PM to Midnight Midnight to 7 AM

Table 2-4 Multi-Lane Closures on the I-70 Mainline from Pecos Street to Airport Boulevard

Pecos Street to Airport Boulevard (MP 273 to MP 284.627)								
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Two-Lane Closure**		**Three-Lane Closure**		**Four-Lane Closure**	
			Weekday	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
270.496 (Sheridan Blvd)	274.000 (I-25)	EB	10 PM to Midnight Midnight to 5 AM	11 PM to Midnight Midnight to 6 AM				
274.000 (I-25)	270.496 (Sheridan Blvd)	WB	10 PM to Midnight Midnight to 5:30 AM	11 PM to Midnight Midnight to 7 AM				
274.000 (I-25)	276.572 (SH 2)	EB	10 PM to Midnight Midnight to 5 AM	Midnight to 6 AM				
276.572 (SH 2)	274.000 (I-25)	WB	11 PM to Midnight Midnight to 5 AM	Midnight to 6 AM				
276.572 (SH2)	278.548 (Quebec St)	EB	10 PM to Midnight Midnight to 5 AM	11 PM to Midnight Midnight to 6 AM				
278.548 (Quebec St)	276.572 (SH 2)	WB	10 PM to Midnight Midnight to 5 AM	11 PM to Midnight Midnight to 6 AM				
278.548 (Quebec St)	279.291 (I-270)	EB	10 PM to Midnight Midnight to 5 AM	11 PM to Midnight Midnight to 6 AM				
279.291 (I-270)	278.548 (Quebec St)	WB	10 PM to Midnight Midnight to 5 AM	11 PM to Midnight Midnight to 6 AM				
279.291 (I-270)	282.563 (I-225)	EB	9 PM to Midnight Midnight to 5 AM	10 PM to Midnight Midnight to 7 AM	11 PM to Midnight Midnight to 4 AM	Midnight to 1 AM 2 AM to 5 AM		
282.563 (I-225)	279.291 (I-270)	WB	10 PM to Midnight Midnight to 5 AM	10 PM to Midnight Midnight to 7 AM	11 PM to Midnight Midnight to 5 AM	Midnight to 6 AM		

b. I-270 permitted lane Closure hours

Table 2-5 below set out the times when the Developer shall be permitted to implement lane Closures on I-270 during the Construction Period, provided that, for certainty, no such lane Closures are permitted on a Holiday.

Table 2-5 Single Lane Closures on the I-270 Mainline from I-70 to Vasquez Boulevard

I-70 to Vasquez Boulevard (MM 5.351 to MP 2.358)				
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Weekday**	**Weekend**
5.351 (I-70)	2.358 (Vasquez Blvd)	WB	9 PM to Midnight Midnight to 5:30 AM	10 PM to Midnight Midnight to 7 AM
2.358 (Vasquez Blvd)	5.351 (I-70)	EB	8 PM to Midnight Midnight to 5 AM	10 PM to Midnight Midnight to 7 AM

c. I-225 permitted lane Closure hours

Tables 2-6 and 2-7 below set out the times when the Developer shall be permitted to implement lane Closures on I-225 during the Construction Period, provided that, for certainty, no such lane Closures are permitted on a Holiday.

Table 2-6 Single Lane Closures on the I-225 Mainline from I-70 to 6th Avenue

I-70 to 6th Avenue (MP 11.997 to MP 8.954)				
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Weekday**	**Weekend**
11.997 (I-70)	8.954 (6th Ave)	SB	8 PM to Midnight Midnight to 5:30 AM	6 PM to Midnight Midnight to 5 AM
8.954 (6th Ave)	11.997 (I-70)	NB	7 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM

Table 2-7 Multi-Lane Closures on the I-225 Mainline from I-70 to 6th Avenue

I-70 to 6th Avenue (MP 11.997 to MP 8.954)								
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Two-Lane Closure**		**Three-Lane Closure**		**Four-Lane Closure**	
			Weekday	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
11.997 (I-70)	8.954 (6th Ave)	NB	Midnight to 5:30 AM	1 AM to 8 AM				
8.954 (6th Ave)	11.997 (I-70)	SB	10 PM to Midnight Midnight to 5 AM	Midnight to 7 AM				

2.11.9 Permitted interchange ramp lane Closure hours

a. I-70 Mainline interchange entrance and exit ramp lane Closure hours

Table 2-8 sets out the times when the Developer shall be permitted to implement lane Closures on ramps on the I-70 Mainline during the Construction Period, provided that, for certainty, no such lane Closures are permitted on a Holiday; and

i. Temporary ramp Closures will only be permitted if:

A. An alternate route or temporary detour is provided;

B. Such Closure is for a duration of 48 hours or less; and

C. It is Approved by the Department.

ii. Two consecutive eastbound and westbound exit ramps are not permitted to be subject to a Closure at the same time.

Table 2-8 Permitted Ramp Closures on the I-70 Mainline from Pecos Street to Airport Boulevard

Pecos Street to Airport Boulevard (MP 273 to MP 284.627)						
Exit #	**Crossroad Name**	**Direction**	**On-Ramp**		**Off-Ramp**	
			Weekday	**Weekend**	**Weekday**	**Weekend**
273	Pecos Street	WB	6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM
		EB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM	6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM
275A	Washington Street	EB	6 PM to 5:30 AM 9 AM to 3 PM	7 PM to Midnight Midnight to 10 AM	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM
		WB	9 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM	6 PM to 5:30 AM 9 AM to 3 PM	7 PM to Midnight Midnight to 10 AM
275B	Brighton Boulevard	EB	7 PM to 5:30 Am 10 Am to Noon	7 PM to Midnight Midnight to 10 AM	6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM
		WB	6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM	7 PM to 5:30 Am 10 AM to Noon	7 PM to Midnight Midnight to 10 AM
275C	York Street	EB	NO RAMP EXISTS		7 PM to 5:30 Am 10 AM to Noon	8 PM to Midnight Midnight to 9 AM
		WB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM	NO RAMP EXISTS	
276A	Steele Street	EB	6 PM to 5:30 AM 9 AM to 3 PM	7 PM to Midnight Midnight to 10 AM	7 PM to 5:30 Am 10 Am to Noon	7 PM to Midnight Midnight to 10 AM
		WB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM	6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM

Pecos Street to Airport Boulevard (MP 273 to MP 284.627)						
Exit #	**Crossroad Name**	**Direction**	**On-Ramp**		**Off-Ramp**	
			Weekday	**Weekend**	**Weekday**	**Weekend**
276B	Colorado Boulevard NB	EB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM	NO RAMP EXISTS	
	Colorado Boulevard SB		6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM	NO RAMP EXISTS	
	Colorado Boulevard		NO RAMPS EXISTS		6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM
	Colorado Boulevard NB	WB	8 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM	NO RAMP EXISTS	
	Colorado Boulevard		NO RAMP EXISTS		8 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM
277	Dahlia Street / Holly Street / Monaco Street (existing slip ramps)	WB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM	7 PM to Midnight 10 AM to Noon	7 PM to Midnight Midnight to 10 AM
		EB	7 PM to Midnight 10 AM to Noon	8 PM to Midnight Midnight to 9 AM	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM
278	Quebec St	WB	9 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM	9 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM
		EB	9 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM	10 PM to Midnight Midnight to 5:30 AM	11 PM to Midnight Midnight to 8 AM
280	Havana St	WB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM	7 PM to 5:30AM 10 AM to Noon	7 PM to Midnight Midnight to 10 AM
		EB	7 PM to 5:30AM 10 AM to Noon	7 PM to Midnight Midnight to 10 AM	8 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM

Pecos Street to Airport Boulevard (MP 273 to MP 284.627)						
Exit #	Crossroad Name	Direction	On-Ramp		Off-Ramp	
			Weekday	Weekend	Weekday	Weekend
281	Peoria Street	WB	9 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM	8 PM to Midnight Midnight to 5:30 AM	9 PM to Midnight Midnight to 8 AM
		EB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM	10 PM to Midnight Midnight to 5:30 AM	11 PM to Midnight Midnight to 8 AM
282	I-225 NB	WB	10 PM to Midnight Midnight to 5:30 AM	Midnight to 8 AM	10 PM to Midnight Midnight to 5:30 AM	Midnight to 8 AM
283	Chambers Road	EB	6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM	10 PM to Midnight Midnight to 5:30 AM	11 PM to Midnight Midnight to 8 AM
		WB	10 PM to Midnight Midnight to 5:30 AM	11 PM to Midnight Midnight to 8 AM	6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM
285	Airport Boulevard NB	EB	NO RAMP EXISTS		6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM
	Airport Boulevard SB		NO RAMP EXISTS		8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM
	Airport Boulevard		6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM	NO RAMP EXISTS	
	Airport Boulevard NB	WB	NO RAMP EXISTS		6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM
	Airport Boulevard SB		NO RAMP EXISTS		6 PM to 5:30 AM 9 AM to 3 PM	6 PM to Midnight Midnight to 11 AM
	Airport Boulevard		8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM	NO RAMP EXISTS	

2.11.10 State Highway and arterial roadway permitted lane Closure hours

Tables 2-9 to 2-12 below set out the times when the Developer shall be permitted to implement lane Closures during the Construction Period, provided that, for certainty, no such lane Closures are permitted on a Holiday. During non-permitted Closure hours, all lanes and turn lanes as they exist prior to construction must be maintained.

Table 2-9 Brighton Boulevard/York Street Single Lane Closure Times

Brighton Boulevard/York Street from 6th Ave to York St (MP 8.954 to MP 0.961)				
Arterial Single-Lane Closure Schedules				
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Weekday**	**Weekend**
8.954 (6th Ave)	11.997 (I-70)	NB	7 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM
11.997 (I-70)	8.954 (6th Ave)	SB	8 PM to Midnight Midnight to 5:30 AM	8 PM to Midnight Midnight to 9 AM
0.000 (I-70)	0.961 (York St)	NB	Anytime	Anytime
0.961 (York St)	0.000 (I-70)	SB	Anytime	Anytime

Table 2-10 Steele Street/Vasquez Boulevard Single Lane Closure Times

Steele Street/Vasquez Boulevard from I-70 to 56th Ave (MP 290.980 to MP 292.479)				
Arterial Single-Lane Closure Schedules				
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Weekday**	**Weekend**
290.980 (I-70)	292.479 (56th Ave)	NB	7 PM to 8 AM 10 AM to Noon	6 PM to Midnight Midnight to 11 AM
292.479 (56th Ave)	290.980 (I-70)	SB	6 PM to 7 AM 10 AM to 11 AM	6 PM to Midnight Midnight to 11 AM

Table 2-11 Colorado Boulevard Single Lane Closure Times

Colorado Boulevard from US 40 to Vasquez Blvd (MP 5.993 to MP 9.843)				
Arterial Single-Lane Closure Schedules				
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Weekday**	**Weekend**
5.993 (US 40)	8.660 (I-70)	NB	7 PM to Midnight Midnight to 5 PM	Anytime
8.660 (I-70)	5.993 (US 40)	SB	6 PM to 5:30 AM 10 AM to 3 PM	Anytime
8.660 (I-70)	9.842 (Vasquez Blvd)	NB	Anytime	Anytime
9.842 (Vasquez Blvd)	8.660 (I-70)	SB	Anytime	Anytime

Table 2-12 Quebec Street Single Lane Closure Times

Quebec Street from I-70 to I-270 (MP 8.553 to MP 8.898)				
Arterial Single-Lane Closure Schedules				
Beginning of Section (MP)	**End of Section (MP)**	**Direction**	**Weekday**	**Weekend**
8.553 (I-70)	8.898 (I-270)	NB	7 PM to Midnight Midnight to 2 PM	5 PM to Midnight Midnight to 1 PM
8.898 (I-270)	8.553 (I-70)	SB	6 PM to 5:30 AM 9 AM to 3 PM	5 PM to Midnight Midnight to 1 PM

2.11.11 Permitted Local Agency Roadways lane Closure hours

In performing the Construction Work on Local Agency Roadways, lane Closures shall only be permitted during the following hours:

a. Arterials, collectors– 8:30 AM to 3:30 PM; and

b. Local residential streets – 7:00 AM to 5:00 PM

2.11.12 Queue Lengths during Construction

The Developer shall monitor queue lengths on all roads within the Project whenever a lane Closure is in effect. The Developer shall adjust the traffic control devices, including advance signing, to provide advance warning to motorists of stopped traffic.

2.11.13 Lane Closure Violations

a. Any lane Closure that results in a breach of, or is not permitted by any of Sections 2.11.5, 2.11.8, 2.11.9, 2.11.10 or 2.11.11 above shall result in the accrual of Construction Closure Deductions in accordance with, and subject to the terms of, Schedule 6 Performance Mechanism.

b. Any Closure that results in a breach of, or is not permitted by any of Sections 2.5.3, 2.6, 2.7, or 2.9 shall result in the accrual of Construction Closure Deductions in accordance with, and subject to the terms of, Schedule 6 Performance Mechanism.

c. For any violation of the permitted lane Closure times for traffic control, a written notice to stop Construction Work will be imposed on the Developer at the start of the next Working Day. Construction Work shall not resume until the Developer assures the Department, in writing, that there will not be a reoccurrence of the violation.

2.11.14 Construction Phasing Minimum Lane Requirements

a. I-70 Mainline lane restrictions

   i. Minimum lane widths for travel lanes on the I-70 Mainline shall be 11 feet. Minimum outside and inside shoulder widths on the I-70 Mainline shall be two feet. Emergency pull outs shall be accommodated as required by this Section;

   ii. If the I-70 Mainline is reduced to a single lane in one direction, the Developer shall provide a minimum clear width of 16 feet to accommodate oversize vehicles or provide alternate route planning for oversize vehicles; and

   iii. The same number of existing lanes shall be maintained, unless otherwise permitted by this Section.

b. I-70 Mainline interchange entrance and exit ramp lane restrictions

   i. Minimum lane widths for ramps shall be 11 feet;

ii. Minimum shoulder width shall be two feet; and

iii. A minimum of one lane shall remain open on all ramps.

c. I-70 Mainline interchange roadways, 46th Avenue and Stapleton Drive lane restrictions

i. Minimum lane widths for I-70 Mainline interchange roadways, 46th Avenue and Stapleton Drive shall be 11 feet;

ii. Minimum shoulder width shall be two feet; and

iii. Curb and gutter sections do not require a two foot shoulder.

d. Other roadways lane restrictions

i. Minimum lane widths for local roads shall be 11 feet;

ii. Minimum shoulder width shall be two feet; and

iii. Curb and gutter sections do not require a two foot shoulder.

2.11.15 Weekly Lane Closure Notification

The Developer shall submit, for Information, lane Closures and Construction Work hours to the Department by Thursday 10:30 a.m. of the week in advance of implementation (for work Sunday through Saturday), unless required by construction emergencies or other reasonably unforeseen events. The Lane Closure Report, as provided in Appendix A of this Section, shall be used for the weekly submittal.

2.11.16 Noise Control Ordinance

The Developer shall obtain required Permits and comply with all Local Agency requirements for noise control ordinances in relation to Construction Work. The noise ordinance mitigation and Construction Work hours should be reflected on the MHT and TCP.

2.11.17 Detour Routes

Only State highways shall be used for I-70 Mainline detour routes. Local Agency Roadways proposed to be used as detours shall be approved by the Local Agency. All detour routes shall be the shortest length possible.

2.11.18 Trail and Pedestrian Impacts

a. The Developer shall comply with all requirements of Schedule 17 Environmental Requirements.

b. Existing trail systems, temporary trails, sidewalks, and pedestrian routes shall be maintained at all times. The Developer shall meet all requirements of the Americans with Disabilities (ADA) Act; and

c. The following restrictions shall apply to existing trail systems in the vicinity of the Project:

i. No trail closures shall be allowed; and

ii. Temporary trail detours will be allowed under the following conditions:

A. PIP requirements shall be identified and appropriate public notifications provided; and

B. The Developer shall comply with the CDOT *Construction Detour Standards for Multi-Use Trails*.

2.11.19 Emergency Pullouts

a. The Developer shall provide Emergency pullouts on the I-70 Mainline for disabled vehicles, staging of incident management, and law enforcement vehicles, when shoulder widths are less than eight feet. Emergency pullouts shall be provided between each interchange or at 0.5-mile spacing, whichever is less. Interchange distance shall be measured from ramp

gore to ramp gore in the same direction of travel. The minimum pullout length shall be 150 feet, not including transitions. Pullouts shall be placed on the outside shoulder only; and

b. Transitions shall be made at 15:1 or greater. The minimum pullout width shall be 14 feet measured beyond the travel lane. The pullouts shall be signed for emergency parking only, shall have a paved surface, shall include advance signing in compliance with the FHWA *Manual on Uniform Traffic Control Devices* (MUTCD), and shall not be subject to ponding or other weather-related conditions that could render them unsafe or ineffective. Snow removal in Emergency pullouts is the responsibility of the Developer.

2.11.20 Courtesy Patrols

The Developer shall coordinate with the courtesy patrols as part of the implementation of the IMP. Schedule 11 Operations and Maintenance Requirements details the courtesy patrol requirements.

2.11.21 Uniformed Traffic Control

a. The Developer shall employ off-duty police officers to provide traffic control and traffic enforcement throughout the Project as required. Uniformed Traffic Control includes; scheduling, coordinating and furnishing a uniformed police agency officer from the Local Agency and/or the Colorado State Patrol (CSP) to perform uniformed traffic control for any traffic control Activity including but not limited to:

   i. Lane Closures to I-70 Mainline (including ramps);

   ii. Night construction on I-70 Mainline (including ramps);

   iii. Lane Closures on Local Agency or CDOT Roadways;

   iv. Night construction on Local Agency or CDOT Roadways;

   v. Periods of active Traffic Control Management on all Roadways; and

   vi. As necessary to ensure safety and efficient operations as identified in the Contractor's TMP.

b. The uniformed police agency officer shall have completed *The Safe and Effective Use of Law Enforcement Personnel in Work Zones* training course. The Developer shall provide to the Department for Information, copies of documentation certifying the officer's successful completion of this course.

c. If not provided by the Local Agency and/or the CSP, the Developer shall furnish a vehicle for the officer to use in performing uniformed traffic control. The Developer shall be responsible for licensing, insuring, servicing, and fueling the vehicle. Each traffic control vehicle shall furnish Class 1 SAE certified light bar and control panel for exclusive use by uniformed police agency officers while performing Uniformed Traffic Control. The light bar shall have the following configuration:

   i. Minimum of 44 inches in length, and shall be either permanently or temporarily attached to the top of the vehicle;

   ii. Flash red on the driver side and blue on the passenger side;

   iii. Equipped with an amber-colored directional device in the rear of the bar;

   iv. Have alley and takedown lights;

   v. Control panel shall be capable of controlling the front of the bar and the rear of the bar separately; and

   vi. The traffic advisor shall be controlled separately.

d. The light bars shall be mounted on traffic control vehicles, and shall be maintained in good operating condition at all times. The Developer shall obtain a permit from the police or

sheriff department, as appropriate, for the use of the light bars. The Developer shall keep the light bars covered at all times when the traffic control vehicle is being used by someone other than the authorized uniform police agency officer.

2.12 Construction Requirements

2.12.1 The Developer shall provide installation, maintenance, and removal of all temporary traffic control devices.

2.12.2 Temporary Traffic Control Devices

a. Construction Signing

Construction signing within the Project and all detours shall comply with CDOT *Standard Specifications*, the MUTCD and all other applicable standards set forth herein. Wood signposts conforming to CDOT *Standard Specifications* will be allowed for installation of temporary signs. No posting on Utility poles or other permanent sign posts.

b. Temporary Traffic Signals and Temporary Ramp Meter Stations

Temporary traffic signals and ramp meter shall comply with Schedule 10, Section 11 Signing, Pavement Marking, Signalization, and Lighting. Upon discovery of a signal malfunction, the Developer shall immediately notify the entity responsible for the signal.

c. Pavement Marking and Signing

The Developer shall furnish, apply and remove pavement marking material in accordance with CDOT *Standard Specifications*. Pavement striping shall meet the conformity of lines (including no overspray), dimensions, patterns, locations and details established in the Developer's TCP and MHT. The Developer shall comply with the criteria for retro reflectivity in Table 2-13 for striping material.

i. Hydro blasting, or other methods that do not result in scarring of permanent pavements shall be used for removal of temporary striping; and

ii. Pavement marking striping shall be maintained and measured for performance.

2.12.3 Pavement Markings

The Developer shall provide all pavement markings meeting the minimum retro-reflectivity as shown in Table 2-13. The Developer shall follow the readings procedure as shown in Schedule 10, Section 11 Signing, Pavement Markings, Signalization, and Lighting Project Special Provisions 627.

Table 2-13 Pavement Marking Reflectivity

Color	Retro-reflectivity Reading (R) in a one-mile section (mcd/m^2/lux)
White	R $\geq$ 375 (Newly applied marking less than 3 weeks old) Newly applied marking minimum 375 mcd/m^2/lux. Less than this reading for newly applied marking; remove and replace, impose a Working Time Violation Incident and stop work.
Yellow	R $\geq$ 275 (Newly applied marking less than 3 weeks old) Newly applied marking minimum 275 mcd/m^2/lux. Less than this reading for newly applied marking; remove and replace, impose a Working Time Violation Incident and stop work

2.12.4 Glare Screen, Barrier Reflector Strips and of Temporary Traffic Control Devices

a. The Developer is required to have 18 inch glare screen on all temporary barrier located between I-70 Mainline opposing traffic located within four feet of the barrier;

b. Barrier reflector strips shall be installed on all temporary barrier, both right and left sides, as per the CDOT Standard S-612-1. The spacing between each three foot panel shall be no more than seven feet; and

c. Delineators shall be used throughout the Project, including lighted areas.

2.12.5 Maintenance of Temporary Traffic Control Devices

The Developer shall be responsible for the maintenance of all temporary traffic control devices within the Project, including the local street system. Temporary traffic control devices shall meet the acceptable standard as defined by the ATSSA *Quality Guidelines for Work Zone Traffic Control Devices*.

2.12.6 Detours and Detour Pavement

a. Any detour pavement shall be designed according to the requirements, as provided in Schedule 10, Section 6 Roadway Pavements;

b. Detour pavement locations shall be generally described in the Developer's TMP and detailed in the Accepted TCP;

c. The Developer shall obtain written approval from the affected Local Agency prior to use of any local streets for detours;

d. Detours that use existing street pavements shall be subject to pavement repair or replacement where it is determined that the condition of the existing pavement has noticeably deteriorated over the duration of its use as a detour; and

e. The Developer shall be responsible for damage on any existing streets used for detours and shall repair any damages to the existing condition, as directed by the Department.

2.12.7 Temporary Lighting

The Developer shall maintain temporary lighting at a level equivalent to existing lighting provided within the Site. Any existing lighting that is not in operation when NTP 2 is issued shall be remedied by the Developer within 60 Calendar Days after the issuance of NTP 2.

2.13 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the time frames specified below:

Table 2-14 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
List of MOT Task Force members	Acceptance	30 Calendar Days after issuance of NTP 1
Transportation Management Plan (TMP)	Approval	Prior to the issuance of NTP 2
Incident Management Plan (IMP)	Acceptance	30 Calendar Days after issuance of NTP 1
Department MOT Variance request	Approval	30 Calendar Days prior to implementation
Local Agency MOT Variance approval	Information	Promptly after MOT Variance approved
Modifications to RTD station access or bus stop locations	Information	Prior to RFC Documents
Lane Closures and Construction Work Hours	Acceptance	Thursday 10:30 AM the week in advance of implementation
MOT operations and analysis	Acceptance	Submit with TCPs
Temporary Traffic Control Plan (TCP)	Acceptance	Prior to RFC Documents
Method of Handling Traffic (MHT)	Acceptance	Prior to RFC Documents
Uniformed traffic control certifications	Information	14 Calendar Days prior to implementation

2.14 Appendices

Appendix A Lane Closure Report

Appendix A
Lane Closure Report

LANE CLOSURE REPORT FOR THE WEEK OF:		Prepared by:	
Highway No:		Region:	
Project Location Description (nearest town, intersection, etc.)		Project Info Line/Email:	
Proj. Start Date:	Est. Completion Date:	Brief Description of Project:	
CDOT Project Engineer:		Phone:	Mobile:
Contractor & Contact (Prime)		Phone:	Mobile:
Other Contact:			

DAY	DATE	TIMES	LOCATION OF CLOSURE	MM# to MM#	Direction	LANE(S) CLOSED	DESCRIPTION OF CURRENT WORK
SUN					**N S** **E W**		
MON					**N S** **E W**		
TUE					**N S** **E W**		
WED					**N S** **E W**		
THU					**N S** **E W**		
FRI					**N S** **E W**		
SAT					**N S** **E W**		
OS/OW Restrictions, Detours, Speed Reductions, Etc.:							

3. ITS AND TOLLING EQUIPMENT

3.1 General

3.1.1 The Developer is responsible for the design and construction of the Intelligent Transportation System (ITS) infrastructure Elements for the Project as outlined in this Section and summarized in Appendix B Responsibility Matrix.

3.1.2 The ITS system Elements include various devices, such as Variable Message Signs (VMS), Side Mounted Variable Message Signs (SMVMS), Closed Circuit Television (CCTV), Microwave Vehicle Radar Detection (MVRD), Travel Time Indicators (TTI), Road Weather Information Systems (RWIS), Lane-Use Signals (LUS) and Automatic Traffic Recorders (ATR). In addition, the ITS system includes the various components that make up the communication system, such as conduit, fiber optic cable, fiber optic cable network design, fiber splicing, Ethernet switches, routers, racks, rack mounts, Uninterruptable Power Supply (UPS), power generators, grounding, cabinets and incidental equipment.

3.1.3 The Developer is responsible for the design, construction and coordination with the Electronic Toll Collection (ETC) System Integrator for their design of certain ETC infrastructure Elements for the Project. The ETC System Elements, for which the ETC System Integrator has responsibility, include additional items such as Automatic Vehicle Identification (AVI) Readers, Automatic License Plate Recognition (ALPR) Cameras, Loop Detectors, Lane Controllers, Transaction Status Indicator Beacons/enforcement beacons. The ETC System will rely on the fiber optic communications network to link the ETC field devices to the ETC back-office.

3.1.4 The ITS and ETC fiber optic communications network extends beyond the construction work area and includes interconnections between several nodes which are Node 1 near I-25/23rd, Node 2 near I-25/70th, a new node at I-70 and Airport Blvd, and the Colorado Transportation Management Center (CTMC) in Golden at 425 Corporate Circle, Golden 80401.

3.1.5 The Developer shall install a node building at I-70 and Airport Boulevard which shall house the ETC equipment and also house the ITS system equipment necessary between the fiber optic backbone and the ITS field equipment. The Developer's and the ETC System Integrator's responsibilities are further defined in this Section.

3.1.6 The Developer shall retain all intellectual property regarding innovative design.

3.2 Applicable Standards

All Construction Work required to be performed by the Developer pursuant to this Section shall comply with Schedule 10A Applicable Standards and Specifications, the relevant requirements listed in this Section, and Good Industry Practice. In addition, use the references as provided in Schedule 29 Reference Documents as supplementary information, such as the Interstate Access Request (IAR).

3.3 Legacy Equipment

Due to the risk of obsolescence, equipment should not be purchased or ordered more than six months prior to the installation date for any piece of equipment without prior written Acceptance by the Department.

3.4 Schedule

Equipment order schedules should be factored into the Developer's schedule, (reference Schedule 8 Project Administration) to include adequate time for fabrication and delivery.

3.5 The ETC System Integrator and Developer Responsibilities

3.5.1 The ETC System Integrator shall be responsible for procuring, terminating and installing the ETC System per manufacturer instructions and according to the industry standards in accordance with the E-470 Tolling Services Agreement. This includes the loop detector wire that activates the transaction beacons and ALPR cameras, TTI's over the Tolled Express Lanes, ETC equipment required in the cabinets, and terminating the connections, including the Developer assigned fiber

for tolling and posting toll rates to the VTMS signs. The ETC System Integrator shall test the ETC equipment to ensure that the toll tags are accurately read. In addition, the ETC System Integrator shall be responsible for the procurement and installation of any equipment necessary in the node building at I-70 and Airport Blvd and Node 2 required for the ETC, including racks. The ETC System Integrator shall be responsible for any software necessary to collect the tolls, compile the transactions, violation monitoring from the ALPR cameras, etc.

3.5.2 The Developer shall be required to procure the following equipment and install it in accordance with E-470's design, the cabinets, UPS's, conduits, VMTS signs, sign supports and any ancillary equipment, connections, attachments, brackets, sealants, etc. The Developer shall also provide the fiber network design, power and lateral conduits between all ETC equipment, between the VMTS signs and into Node 1, 2, I-70 and Airport Blvd, CTMC in Golden and E-470/6th in Aurora. The Developer shall provide and terminate all power to all of the ETC equipment including in the node buildings. This also includes any UPSs and Generators for backup as required for the entire ITS and ETC System defined in this Section.

3.5.3 The Developer shall be responsible to coordinate and provide all traffic control for the ETC System Integrator.

3.5.4 The Developer shall be responsible to coordinate design submittals between the ETC System Integrator and the Department. The ETC System Integrator and the Developer shall work together and coordinate Construction Work Schedules. The Department is not responsible for coordination delays between the ETC System Integrator and the Developer.

3.5.5 As described in this Section the civil infrastructure must be installed before the ETC System Integrator can do their installation. The civil infrastructure includes item such as conduit, electrical power, gantries/sign structures, poles, foundations, cabinets, UPS's, fiber/fiber network, VTMS signs, etc. After the civil infrastructure is installed the ETC integrator can install the equipment described in this section such as AVI antennas/brackets, ALPR cameras, loop detector wire, electronic tolling lane controller, enforcement beacons, cabling and conductors to connect the equipment, etc.

3.5.6 The parties shall coordinate schedules and the Developer shall provide 14 days prior notice to the ETC System Integrator when they are ready for the installation of the toll equipment to be installed that the ETC System Integrator is responsible for in this Section.

3.5.7 The ETC System Integrator shall be allowed 14 Calendar Days per site regarding testing (which should be built into the Developer's Project Schedules) and the Developer is responsible for traffic control within lane closures hours prescribed in Schedule 10, Section 2 Maintenance of Traffic. The parties shall coordinate schedules.

3.5.8 The ETC System Integrator's work cannot start until the final pavement in the Tolled Express Lane is complete in place and the median barrier is complete in place.

3.6 Zayo and Developer Responsibilities

3.6.1 The Utility Relocation Agreement (URA) between CDOT and Zayo (which is included in the Reference Documents) defines the responsibilities of the parties as outlined in this Section and the Developer shall be responsible for performing all Utility Work in accordance with Utility Work Orders issued pursuant to that URA and Schedule 10, Section 4 Utilities.

3.6.2 The Developer shall be responsible to furnish and install a conduit duct bank as described in this Section. Zayo will be responsible to furnish and install the Department's 144 strand fiber optic cable called the backbone. This installation includes splicing the 144 strand fiber optic backbone cable the entire length which is between Node 1 and the new Node Building at I-70 and Airport Road. This also includes Zayo installing the 96 strand fiber optic cable for the City and County of Denver (CCD) between Node 1 and the new Node Building at I-70 and Airport Blvd and respective splicing. The Developer and the Zayo shall coordinate schedules to avoid delays. The Department will not be responsible for delays. The Developer should be aware that a 45 Calendar Day notice by Zayo to its customers is required for any service disruptions and this should be built

into the Developer's Project Schedules. Reference Schedule 8 Project Management for scheduling requirements.

3.7 Colorado Transportation Management System Software and Video Management System

3.7.1 References to CTMS in this document are the software used at the CTMC. The CTMS controls statewide VMS's, Active Traffic Management on US 36, I-25, and I-70 West, monitors the equipment connected to the software in real time for failures, calculates travel time using the TTI, MVRD and Doppler, utilizes the RWIS statewide for road conditions, and replicates information to the states website, called www.cotrip.org, in a usable format for the public to view in real time. While this is only a brief explanation of the CTMS software and its capabilities, it is open source code and will require a thorough understanding of incorporating any new equipment into the system.

3.7.2 The equipment referred to in this section is already compatible with the CTMS and no software development time will be needed. Any new models of equipment that may require software upgrades to the CTMS will be at the responsibility of the Department.

3.7.3 The video management system software controls the statewide camera network and is a shared camera network that includes multiple participating agencies in the Denver Metro area. Any new cameras added to the I-70 Mainline will be incorporated into the video software and this shall be the responsibility of the Department. The Developer will be responsible for the camera installations and terminations and any field trouble shooting required until the camera is fully operational.

3.8 Design and Construction Requirements

3.8.1 The Developer shall design and construct the ITS and ETC infrastructure components. No part or attachment of any equipment shall be substituted or applied contrary to the manufacturer's recommendations and Good Industry Practice. The Developer shall submit ITS device and material sheets for Acceptance to the Department prior to installation. ITS infrastructure locations need to be coordinated between all Sections including Schedule 10, Section 9 Roadway, Section 11 Signing, Pavement Markings, Signalization, Lighting, Section 13 Structures, etc. and the I-70 Phase 1 – Signing, Striping, ATM, and Tolling Concept Plan provided in the IAR.

3.8.2 Conduit Duct Bank and Fiber

a. Design Requirements

i. The Developer will be responsible to furnish and install nine conduits in a duct bank also referred to as the shared trench as described below. Zayo will be responsible for the installation of the Department's 144 count single mode fiber optic backbone cable and CCD 96 stand fiber optic cable (84 count single mode and 12 count multi-mode) in the duct bank installed by the Developer. The conduit duct bank does not include conduits for power sources. Any additional conduits requested or required in the trench shall be Accepted by the Department, such as power, Local Agency requests and private entities;

ii. The Developer shall design new and separate conduit systems (including all hardware, fasteners, and accessories) for communication and power control systems. Longitudinal conduits for the communications network shall be installed within the Right-of-Way (ROW) and as close to the ROW line as practical;

iii. Conduits shall be installed per the National Electrical Code (NEC) requirements including separate conduits for power, communications and fill ratio;

iv. Permanent ramp meters and traffic signals shall be designed and connected to the fiber backbone by the Developer;

v. As described below, there are nine conduits in the shared trench (conduit duct bank). The shared trench is made up of six 6-inch conduits, one 3-inch conduit and two 2-inch conduits (nine conduits total). The ownership of the conduits is as follows. One

3-inch conduit is for the CCD 96 strand fiber optic cable, one 2-inch conduit is for the Department's 144 strand fiber optic cable called the backbone and one 2-inch conduit is for the Department's future use. The future use 2-inch conduit cannot be used for any purposes for this Project. All back feeding fiber optic cable of any kind regarding laterals will require additional conduits for this purpose. These additional conduits can be added to the shared trench for this purpose. The remaining six 6-inch conduits are for Zayo's use and include the Department's additional 36 strand fiber count. Zayo and the Department have an agreement for the 36 strand fiber count and it will pass through the conduit's entire length and cannot be used for the Construction Work communications for any reason. The additional Department's 36 strand fiber count will be included in one of the 6-inch conduits and installed by the Zayo;

vi. All references to conduit in this Section shall be either polyvinyl chloride (PVC) schedule 80 or high-density polyethylene (HDPE) Schedule 80 and ETL/UL listed. The conduit shall be factory lubricated, low friction, high-density conduit constructed of virgin schedule 80. 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. All conduits shall comply with the CDOT *Standard Specifications*; and

vii. The following sets out the Construction Work that is the Developer's responsibility in relation to the shared trench (conduit duct bank):

A. I-70 between Quebec Street and Airport Boulevard

(I) Two 2-inch conduits and one 3-inch conduit, schedule 80 on the south side of the I-70 Mainline and terminate in the new node building at I-70 and Airport Boulevard in the southeast quadrant between the northbound exit ramp to Airport Boulevard and the eastbound entrance ramp to I-70. Access to the node can be from the exit ramp. The location shall be Accepted by the Department. The location shall have safe, easy access for maintenance without the need for complex traffic control;

(II) New conduits on the south side of the I-70 Mainline, in the ROW, approximately five feet from the existing Zayo conduit ducts;

(III) 2-inch lateral conduits, schedule 80 shall be required to the ETC and ITS equipment;

(IV) 24 count single mode fiber optic cable to the lateral equipment;

(V) Separate power conduit, 2-inch minimum, to the equipment for ETC and ITS;

(VI) 144 count single mode fiber optic cable in one 2 inch conduit for CDOT and a 96 stand fiber optic cable in one 3 inch conduit for CCD (84 count single mode and 12 count multi-mode) in the I-70 backbone, both installed by Zayo ;

(VII) Splice all laterals to the backbone;

(VIII) Design electrical Utility Service as described in Schedule 10, Section 4 Utilities;

(IX) Man holes shall be spaced at approximately 1,200-foot intervals. Pull boxes will not be allowed for the backbone conduits; and

(X) Fiberglass sweeps are allowed.

B. I-70 between York Street and Quebec Street

(I) Nine conduits on the north side of I-70 within 46th Ave. The location shall be Accepted by the Department. The location shall have safe, easy access for maintenance without the need for complex traffic control;

(II) The nine conduits shall be stacked in a trench that shall be no more than 18 inches wide as described above. The trench shall be able to handle traffic loads without damaging the conduits. If the duct bank is installed under live traffic, flow fill is required in the trench to the bottom of the pavement;

(III) The nine conduits in the duct bank shall include:

(aa) Six 6-inch conduits (schedule 80) for Zayo

(bb) One 3-inch conduit (schedule 80) for CCD and

(cc) Two 2-inch conduits (schedule 80) for CDOT.

(IV) 2 inch lateral conduits, schedule 80 will be required to ETC and ITS equipment;

(V) 24 count single mode fiber optic cable to the lateral equipment;

(VI) Separate power conduit, 2-inch minimum, to the equipment for ETC and ITS;

(VII) 144 count single mode fiber optic cable in one 2 inch conduit for CDOT and a 96 stand fiber optic cable in one 3 inch conduit for CCD (84 count single mode and 12 count multi-mode) in the I-70 backbone, both installed by Zayo;

(VIII) Splice all laterals to the backbone;

(IX) Utility power;

(X) Man holes shall be spaced at approximately 1,200-foot intervals. Pull boxes will not be allowed for the backbone conduit; and

(XI) Fiberglass sweeps are allowed.

C. I-70 between Pecos Street and York Street

(I) Two 2-inch conduits and one 3-inch conduit on the south side of the I-70 Mainline. The location shall be Accepted by the Department. The location shall have safe, easy access for maintenance without the need for complex traffic control;

(II) 2-inch lateral conduits, schedule 80 will be required to ETC and ITS equipment;

(III) 24 count single mode fiber optic cable to the lateral equipment;

(IV) Separate power conduit, 2-inch minimum, to the equipment for ETC and ITS;

(V) 144 count single mode fiber optic cable in one 2 inch conduit for CDOT and a 96 stand fiber optic cable in one 3 inch conduit for CCD (84 count single mode and 12 count multi-mode) in the I-70 backbone, both installed by Zayo;;

(VI) Splice all laterals to the backbone;

(VII) Design electrical Utility Service as described in Schedule 10, Section 4 Utilities;

(VIII) Man holes shall be spaced at approximately 1,200 foot intervals. Pull boxes will not be allowed for the backbone conduit; and

(IX) Fiberglass sweeps are allowed.

D. Node building at I-70 and Airport Boulevard

(I) The node building, with whole building uninterrupted power source capable for 30 minutes of continuous battery power and an external natural gas generator;

(II) Node building size equal to or greater than 14 feet by 28 feet;

(III) Gravel lot with parking available for two vehicles;

(IV) Six foot high chain link fence with 24 foot wide double gate. Total fenced area of 50 feet by 50 feet;

(V) Node includes all racks for ITS and ETC equipment;

(VI) Separated and locked racks for individual secured access;

(VII) Three phase, 120/208 volt power service (from the Utility meter), to the node building with generator and dual UPS backup; and

(VIII) The Developer is required to provide power, switches, ETC and ITS equipment for Ethernet communications, as described in the Project Special Provisions.

b. Construction Requirements

i. Wet Utilities shall not be permitted in the shared trench (conduit duct bank) and shall not be permitted within four feet on either side of the shared trench. Wet Utilities are not allowed above or below the conduit duct bank except for crossings. The conduit duct bank shall be no more than 18 inches wide and provide four feet of cover, plus the surface thickness of the pavement or sidewalk, measured from the top of the conduit. If the conduit duct bank is deeper than six feet the Department will be required to Accept the installation;

ii. Any interference between other conduits, drainage pipes and outlets shall be mitigated. The fiber conduits perpendicular to any drainage outlets shall be cast in flow fill to prevent it from floating upward to the surface. A design by the Developer shall be submitted for Acceptance if at least a 48 inch depth from the top of the conduit trench to the surface cast in flow fill cannot be accommodated. For bores that contain more than one conduit, the conduit shall be bundled together and contained in a single bore;

iii. If the duct bank is installed under live traffic, flow fill is required in the trench to the bottom of the pavement; and

iv. Aerial fiber optic cable is not allowed.

3.8.3 Electrical Power

a. Design Requirements

The Developer shall provide single phase alternating current (AC) power service to every ITS and ETC device and cabinet within the Site, which includes metered service and power disconnect within close proximity of the equipment and within the ROW. The proposed node at I-70 and Airport Boulevard has other power requirements defined in this Section and the single phase AC does not apply;

i. Economizing the power services into one meter is allowed, however separate disconnects are required for each device which serves as a maintenance breaker to

avoid entire power shutdowns. However, the traffic signals, ETC equipment and ramp meters require separate meters;

ii. Any remaining existing services shall be metered, if not already, to include a power disconnect within close proximity of the equipment and must be within the ROW. The Developer shall obtain approval of the power service design from the power service provider. The Developer shall coordinate and meet all requirements, as specified by the power service provider, for the complete and operational power service to all required locations; and

iii. The Developer shall be responsible for the coordination of Utility service as described in Schedule 10, Section 4 Utilities.

b. Construction Requirements

The Developer shall make appropriate arrangements with the power service provider for installation or relocation of power service. The Developer shall also be responsible for all costs of installing or relocating Utility services, including involvement with the power service provider at locations for new services. The Developer shall ensure the transition and reassignment of electrical service to the Department's name and that there is no disruption in service.

3.8.4 Location, Protection of ITS and ETC Systems and Worker Safety

a. Design Requirements

i. The Developer shall design all ITS and ETC infrastructure within ROW such that Routine Maintenance thereof will not require a Closure, affect traffic operations, or require complex traffic control, except for the overhead LUS's. ITS and ETC Elements shall not be located in the I-70 Mainline median, except the center support of freeway VMS, VTMS, TTI related to the Tolled Express Lane and AVI, ALPR, and transaction status indicator beacon support structures. All proposed locations shall be Accepted by the Department prior to installation to ensure that maintenance access is safe;

ii. All existing underground Utilities, within ROW, and all ITS and ETC infrastructure Elements shall be designed to avoid or minimize conflicts with these facilities. The Developer shall be responsible for all repairs to facilities damaged during construction. The Developer shall be responsible for maintaining and keeping operational all existing ITS devices during construction. This includes communications and power to CCTV, VMS, Doppler's, MVRD, RWIS and other devices owned by the Department and the CCD; and

iii. The Developer shall protect all new equipment, devices, interconnect wiring, communications devices, communications lines, power supplies, antennas, operator controls, power service, etc. through the installation of an UPS to condition the power to eliminate damage by external and internal sources (including power surges), lightning, induced voltages, and static discharge. A grounding system and protection of devices that are suitable for the specific installation and equipment shall be designed.

b. Construction Requirements

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

ii. The Developer shall construct a grounding system for each ITS and ETC device.

3.8.5 Communications System

a. Design Requirements

i. The communications system is used to transmit data to and from all existing and proposed ITS devices. In addition, the ETC System and ETC System Integrator is responsible for transmitting all ETC tolling data to and from the back-office for processing, issuing of tolls, and updating of information in the lanes;

ii. Refer to Schedule 10, Section 12 Cover MEP System for the communications system requirements for the Cover. Specifically regarding interconnecting the ramp meter system and ATM signing in the event of a partial or full closure in the Cover. This includes the entrance ramp meter system and ATM signing in the Cover, in advance of the Cover and at the Cover Portals being capable of stopping all traffic; and at the closest entrance ramp prior to entering the I-70 Mainline during an incident in both eastbound and westbound directions independently. Refer to Schedule 10, Section 12 Cover MEP System for other requirements that need to be integrated into the system regarding command and control and monitoring of the systems inside the Cover. Items required in Schedule 10, Section 12 Cover MEP System shall not be part of the CTMS software and will require a standalone communications system. The system can utilize the fiber and conduits for a means to pass data to a central system;

iii. The Developer shall design the fiber optic communication system lateral connections from the communications backbone to the field devices and end equipment including the node buildings listed in this Section. The Department currently uses coarse wavelength division multiplexing (CWDM) and dense wavelength division multiplexing (DWDM) technology regarding splicing, which is the current standard that shall be used.

iv. The fiber shall be economized to the degree that four buffer tubes for the Department, one buffer tube for ETC equipment, one buffer tube for connected vehicles technology and the remaining buffer tubes (six remaining) shall be preserved and uncut for future use (e.g. connected vehicles) by the Department. The remaining buffer tubes shall be butt spliced, patched through and terminated at each vault, manhole and node building. Construction Work should be expected in Node 1, Node 2, the new node at I-70 and Airport Boulevard and the CTMC in Golden. If additional buffer tubes are required the Developer shall provide an explanation and will need Acceptance from the Department. The network drawings shall economize the fiber splices using the DWDM and CWDM technology. The Project communications requirements shall include the design of equipment to connect between Node 2 and the proposed nodes. The Developer shall design a system capable of transporting data and video signals between field devices and support the following functional requirements, at a minimum:

A. Provide the Department fiber optic communications connectivity between the field devices, end equipment, the new node at I-70 and Airport Boulevard and Node 2;

B. Splice two fibers at the I-225 and I-25 manhole that connect to the Southmore node building and will provide a ring for the I-70 Mainline device communications. The two fibers on I-225 will need to be OTDR tested for DB loss. The range of acceptable loss can be found in the project special provision;

C. Provide Internet Protocol (IP) Ethernet communication to all devices. The Department will provide IP addressing;

D. Support full-color, real-time video images at a data rate of no less than four MB/s or at the Department standard at the time of construction of the CCTV system for all cameras to a communications hub;

E. All fiber allocations, splicing diagrams, and network drawings shall be prepared by the Developer and submitted to the Department for Acceptance in electronic format;

F. Splicing of fiber optic cable shall be performed in manholes only; and

G. Upgrade the communications from the existing SONET network to Ethernet between the Region 1 KOA office at 18500 E Colfax and the proposed node at I-70 and Airport Boulevard. This involves one additional 24 Strand Single-Mode Fiber Optic (SMFO) that shall be installed on Tower Road between I-70 and Colfax at18500 E Colfax, CDOT Region 1. The fiber shall be terminated into the equipment room at this location, using an existing conduit on Tower Road.

v. The Developer shall furnish all components required to achieve a fully-functioning communications system. The communications system shall be designed based on the following material requirements:

A. The communications backbone being installed on the I-70 Mainline shall consist of a 144-strand single mode fiber optic backbone cable installed by Zayo;

B. The shared trench (conduit duct bank) for the fiber optic backbone and laterals shall include sweeps (conduit breakouts) to separate pull boxes, manholes, vaults, clearly marked regarding ownership. For example the two 2-inch conduits in the shared resource trench will have the mark CDOT Communications, the shared resource boxes shall break out the six 6-inch conduits for Zayo, and the one 3-inch conduit for CCD. All boxes and ownerships shall be clearly marked on the manhole ring, vault cover, or pull box cover. All conduits shall include mule tape with a locate wire;

C. Two 2-inch conduits and one 3-inch conduit on the south side of the I-70 Mainline, between Pecos Street and York Street; two 2-inch conduits and one 3-inch conduit on the south side of the I-70 Mainline, between Quebec Street and Airport Boulevard. The two 2-inch conduits will be owned by the Department and the one 3-inch conduit will be owned by CCD; and

D. Nine conduits (one 3-inch, two 2-inch conduits and six 6-inch conduits) on the north side of the I-70 Mainline, between York Street and Quebec Street. Conduit ownership is as follows:

(I) Two 2-inch conduits are owned by the Department;

(II) One 3-inch conduit is owned by CCD; and

(III) Six 6-inch conduits are owned by Zayo.

vi. Provide separate 24-strand single mode fiber optic cable laterals and conduit from the Department's 144 strand single mode fiber optic backbone to all ITS and ETC field devices, except Doppler Radar units;

vii. Provide separate 12-stand single mode fiber optic cable laterals and conduit from the CCD 96 strand fiber optic cable backbone to all traffic signals and reference CCD standards for fiber optic specifications in

viii. Provide fiber quick disconnects at all unprotected ITS devices and equipment locations where new fiber optic lateral cables are installed and spliced to the main backbone cable. The fiber quick disconnects shall allow the fiber laterals to be disconnected to prevent damage to the fiber backbone in case any of the devices or equipment along the corridor are damaged. The fiber quick disconnect shall be installed in areas where they will not be submerged in water and per the manufacturer's recommendations. Bend insensitive (ITU-T G.657 A) tactical fiber

optic cable with a polyurethane jacket shall be used for all patch cables and shall be fully compatible with all fiber optic laterals;

ix. Provide hardened, extended temperature roadside carrier grade field Ethernet switches with eight 10/100/1000 Ethernet ports in addition to two small form-factor pluggable (SFP) based one Gigabit Ethernet ports. Each switch shall provide ITU- T G.8032 Ethernet Ring Protection Switching, S-VLAN Priority based on C-VLAN ID, Internet Group Management Protocol v2 (IGMP) snooping/filtering, and security access control lists (ACLs) and SNMPv1, SNMPv2, and SNMPv3 management protocols. The switches shall also include sufficiently sized optics for transmitting and receiving data from the node building aggregation Ethernet switches. Per the Project Special Provisions, set out in Appendix A, all switches shall meet 100M/1 GIG, SM SFP Optic, LC Connector, 80 KM Ext. Temp and 100M/1GIG, SM SFP Optic, LC Connector, 10 KM, Extended Temperature SFP specification;

x. All existing and proposed ITS and ETC field devices to be connected to the fiber optic backbone shall communicate via Ethernet switches, unless otherwise stated;

xi. CWDM for lateral splicing utilizing 1430 NM, 1450NM, 1470NM, 1490NM, 1510NM, 1530NM, 1550NM, 1570NM, 1590NM and 1610NM;

xii. DWDM for backbone splicing. Ranges of DWDM can be found in the Project Special Provisions;

xiii. NM SFPs shall be used as the CWDM transport mode, 1310 NM SFPs shall be used as the resilient path transport with ITU-T G.8032 ring protection configuration in both the roadside carrier grade field Ethernet switches and the carrier grade aggregation Ethernet switches to transport the Department field device data to minimize fiber usage and maximize fault tolerance;

xiv. All roadside carrier grade field Ethernet switches shall be fully compatible with the backbone Ethernet switches and aggregation switches;

xv. Passive CWDM Thin Film Filter mux filters shall be used at each roadside field Ethernet switch splice location to split out the appropriate wavelengths. The mux filters and mux filter splices shall be contained in a separate splice enclosure from the splice enclosure containing the lateral fiber cable to backbone fiber cable splices;

xvi. Management System software tool shall be provided to manage carrier grade field Ethernet and Transport product portfolios; and

xvii. Passive 1U rack mount 32-channel Optical Splitter Shelf shall be used in the regeneration building to demux (split) CWDM optical signals out to the paired SFP in the core aggregation switch.

b. Construction Requirements

i. The Developer shall furnish and install the fiber optic communications system and connect all ITS and ETC field Elements to the system;

ii. Prior to performing any Construction Work that may impact existing ITS communications systems, the Developer shall coordinate with the owner of the affected system;

iii. Fiber optic conduit shall be located along 46th Avenue under the sidewalk. It shall not be located in the travel way unless Approved by the Department;

iv. CWDM technology shall be used for lateral splice terminations and the Developer cannot daisy chain more than thee switches; and

v. DWDM technology shall be used for backbone.

3.8.6 Vertical Clearance Requirements

a. Design Requirements

The Developer shall mount all overhead signs, including electronic signs along the I-70 Mainline, with a minimum vertical clearance of 17.5 feet and a maximum of 18.5 feet measured from the roadway surface under the sign panels and/or electronic signs to the bottom of the VMS, VTMS, LUS, walk way, toll equipment or guide sign (low point). Structure cross sections shall be provided and display signing mounting, hangers, equipment, control boxes, conduits, holes, hand holes, vertical clearances and all dimensions. If ATM signage/signals or tolling equipment are planned on structures the vertical clearance is measured to the bottom of the LUS signals, tolling equipment and any future equipment, therefore sign panels and structures must accommodate the additional clearance required for the proposed and future ATM/Tolling. See Schedule 10, Section 11 Signing, Pavement Markings, Signalization, and Lighting for additional information.

b. Construction Requirements

Structure cross sections are required and shall be coordinated with Schedule 10, Section 11 Signing, Pavement Markings, Signalization, and Lighting.

3.8.7 Variable Message Signs

a. Design Requirements

i. The VMS's are large dynamic displays that are used for a wide range of purposes, including providing driver information regarding weather advisories, travel times, amber alerts, toll information, construction, and incident notifications. The Developer shall design a complete VMS system at the approximate locations shown in the I-70 East-Phase 1 Signing, Striping, ATM and Tolling Plan in the IAR;

ii. These new VMSs shall be mounted on a sign bridge and co-located with the static guide signs wherever possible. They shall be centered over the General Purpose Lanes but be visible to all Users. Where ROW permits, an eight foot wide paved area shall be provided, outside of the shoulder, for maintenance access. The sign bridge shall have a locked, secured ladder and walkway so that maintenance personnel can maintain every portion of the sign bridge without the use of a bucket truck. The walkway shall be mesh with a maximum diameter of 0.5 inch to prevent dropped tools and debris from falling onto the travelled way. In addition, the walkway shall be Occupational Safety and Health Administration (OSHA) compliant with side rails and toe kicks. The Developer shall submit a structural design for each VMS structure in accordance with the requirements of Schedule 10, Section 13 Structures. The sign bridge handle shall not prevent the static sign messages from being clearly read and shall be OHSA compliant; and

iii. The Developer shall furnish, install, integrate, and test all new VMS signs and any and all associated equipment necessary to achieve a fully-functioning system. The new VMS signs shall be designed based on the following material requirements, at a minimum:

A. The sign shall utilize light emitting diode (LED) displays;

B. The sign shall be equipped with the ability to display three lines of text with a character height of 18 inches and 18 characters minimum per line;

C. The sign shall be full color matrix;

D. The sign shall utilize a full-color, full-matrix display and utilize a 24 bit red, green, blue color with a 32-35 mm pixel spacing (approximate size 26 feet by 8.5 feet);

E. The sign shall have a walk-in cabinet;

F. The sign viewing angle shall be 30 degrees;

G. The sign shall have a minimum design life of 20 years;

H. The VMS controller and sign must be National Transportation Communications for ITS Protocol (NTCIP) compliant, provide an Ethernet interface, and must be compatible with the Colorado Transportation Management Software (CTMS); and

I. The sign shall have environmental controls inside the cabinet and capable of remote surveillance of all controls, legend and maintenance.

b. Construction Requirements

i. The Developer shall be fully responsible for the furnishing and installation of all VMS signs. The VMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available to ensure proper installation and testing. The installation shall include a 60 Calendar Day burn-in of the complete system;

ii. Each VMS system shall be connected to the communication system using fiber optic laterals extended into the VMS controller cabinet. The Developer shall notify the Department upon installation of each VMS and complete a CDOT Device Data Sheet. The Developer shall be responsible for the integration of all VMS back to the CTMC. The Department shall be responsible for modifying the CTMS software to incorporate the new devices;

iii. The Developer shall submit a VMS Acceptance Test Procedure in accordance with the manufacturer's guidance for Acceptance by the Department. The test procedure shall be performed in the presence of the Department and the manufacturer's representative. The Developer shall notify the Department at least 30 Calendar Days prior to the test date;

iv. The test shall include all items addressed in the Project Special Provisions as listed in Appendix A; and

v. A minimum of eight copies of the Operations Manual detailing the electrical schematics, operation and maintenance of the VMS system, including spare software copies, shall be provided. One copy of the manual shall remain inside the sign housing or control cabinet. One copy shall be delivered to the Department.

3.8.8 Closed Circuit Television

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

a. Design Requirements

i. Provide full CCTV coverage of the entire I-70 corridor, between Pecos Street and Airport Boulevard. The CCTVs shall be at a maximum of one mile separation and provide overlapping coverage up to 1,000 feet in full zoom. Due to the closely spaced bridges and Cover, additional cameras may be required for overlapping coverage. Refer to Schedule 10, Section 12 Cover MEP System for CCTVs inside the Cover;

ii. The CCTV coverage will be provided via Ethernet-based cameras meeting the material requirements;

iii. The CCTV cameras shall be mounted on 40 or 50 foot steel poles as described below with raise and lowering cables for access to the CCTV for cleaning and maintenance capabilities;

iv. See Schedule 10, Section 12 Cover MEP System for additional requirements regarding CCTV coverage under the Cover;

v. All CCTV cameras installed shall meet the following minimum requirements:

A. Digital and Ethernet-based;

B. All-in-one color surveillance dome camera unit;

C. Pan, 220 degree tilt, zoom operation;

D. 35X optical zoom minimum;

E. Minimum illumination no less than 0.5 lux;

F. H.264 video stream or current standard used by the Department at the time of installation;

G. Compatible with the current CCTV standard used by the Department at the time of installation; and

H. Full 360 degree overview with one-click pan, tilt, zoom.

vi. The CCTV camera shall also include a weatherproof dome housing, steel pole, lowering device, mount adapter, camera transformer, attachment hardware and all other hardware, cables, and test equipment necessary for a complete installation. Poles shall be 40 feet in height at interchange locations and 50 feet in height at mainline locations, and shall include the proper foundation. The poles shall also include a lowering device that allows CCTV cameras to be lowered to the ground for maintenance purposes without interfering with any other pole- mounted devices or cabinets.

b. Construction Requirements

i. The Developer shall furnish any new CCTV cameras and carry out all installation, field- testing, burn-in of the system, and connection of each device to the communication system. Existing CCTV cameras in the corridor may not be reused and shall be salvaged and returned to the Department; and

ii. The Developer shall notify the Department upon installation of each CCTV camera and complete a CDOT Device Data Sheet. The Developer shall be responsible for the integration of each new CCTV back to the CTMC. The Department shall be responsible for modifying the video control software to incorporate the new devices.

3.8.9 Microwave Vehicle Radar Detection

The MVRD, also referred to as side-fire radar, are used to collect point data of volume, occupancy, speed, and classification in each lane of travel. The data is used primarily for measuring and analysis of traffic conditions, both real-time and for studies.

a. Design Requirements

i. The Developer shall prepare a design to locate side-fire MVRD units at one half mile spacing both eastbound and westbound between Pecos Street and Tower Road. In addition, the MVRD's shall be designed at 0.5 mile spacing from the exit gore ramp at I-225 northbound to westbound ramp and the exit gore ramp from I-25 northbound and southbound to eastbound I-70 both leading into the Tolled Express Lanes ingress points. Each location shall be accessible by the Department bucket trucks to provide device maintenance and other functions without performing Closures, affecting traffic operations, or requiring complex traffic control; and cannot be placed in the median; and

ii. The Developer shall furnish all new MVRD units and any and all associated equipment necessary to achieve a fully-functioning system. The MVRD units shall detect all individual lanes of travel, including the General Purpose Lanes and Tolled Express Lanes in both directions. Data collection shall include volume, occupancy, speed, and classification.

b. Construction Requirements

The Developer shall furnish all MVRD and carry out all installation, field-testing, and burn-in of the system per the manufacturer's recommendations and the Applicable Standards and Specifications. Each device shall be connected to the communication system using fiber optic laterals. Existing MVRD units may not be reused and shall be salvaged and returned to the Department. The Developer shall notify the Department upon installation of each MVRD device and complete a CDOT Device Data Sheet. The Department shall be responsible for modifying the CTMS software to incorporate these devices.

3.8.10 Travel Time Indicators

TTI sites are comprised of Sirit antennas and readers that detect toll tag transponders in vehicles. While MVRD units give volume, occupancy, and speed data at a given point, the TTI are used to track vehicle travel times across segments spanning from one TTI location to the next.

a. Design Requirements

i. The Developer shall prepare a design to locate TTI units at 0.5 mile spacing in both directions that will read the General Purpose Lanes and the Tolled Express Lanes separately and located before and after each interchange between Pecos Street and Tower Road. TTI units shall be installed between the exit ramp and entrance ramp, at each interchange, to allow Users exiting the facility for a short period of time to be excluded from the travel time calculations. In order to design the TTI's to separately read the General Purpose Lanes and Tolled Express Lanes the device may be placed over the lanes and more TTI units will be required;

ii. In addition, for the Tolled Express Lanes, one set of TTI units shall be located between each ingress/egress point to obtain directional travel times. The Concept of Operations for I-70 East Tolled Express Lanes and the I-70 Phase 1-Signing, Striping, ATM and Tolling Plan in the IAR depict a toll point layout, with currently indicated approximate locations. The toll point locations will need to be coordinated with infrastructure, signing, striping and ATM. The total number of tolling points is five (three in eastbound direction and two in the westbound direction). The approximate locations in the eastbound direction are York Street, Monaco Street, and Havana Street. The approximate locations in the westbound direction are Havana Street and Holly Street;

iii. Each TTI location shall be accessible by Department bucket trucks and replacement shall be able to be accomplished within 15 minutes, if they are installed over lanes; and

iv. The Developer shall furnish all new TTI units and any and all associated equipment necessary to achieve a fully-functioning system. The TTI units must be Sirit 6204 multi-protocol readers and antennae and be able to read both Title 21 and ISO 18000-6C transponder tags. Any existing TTI units along the new Department fiber optic backbone shall be replaced with new multi-protocol units.

b. Construction Requirements

The Developer shall furnish all TTI units and carry out all installation, field-testing, and burn-in of the system per the manufacturer's recommendations and Applicable Standards and Specifications. Each device shall be connected to the communication system using fiber optic laterals. Existing units shall be salvaged and returned to the Department. The Developer shall notify the Department upon installation of each TTI device and complete a CDOT Device Data Sheet. The Developer shall be responsible for the integration of each new TTI to the CTMC. The Department shall be responsible for modifying the CTMS software to incorporate these devices.

3.8.11 Division of Transportation Development Automatic Traffic Recorders

The Division of Transportation (DTD) ATR stations continuously collect vehicle volume and functional classification data using in-pavement loops and piezoelectric sensors. The DTD ATR

locations are to be located in all lanes of I-70 including the Tolled Express Lanes both eastbound and westbound between Holly Street and Dahlia Street and between Havana Street and Central Park Boulevard.

a. Design Requirements

ii. The Developer shall design the DTD ATR counting station. Each new DTD ATR must collect data for all lanes of travel, including the General Purpose Lanes and Tolled Express Lanes in both directions. Communications to the DTD ATR station shall be provided via a lateral from the ITS fiber backbone to a DTD ATR cabinet. A 12 strand SMFO lateral cable shall be provided for the communications. The ATR shall have a dual communications port, one for real time and one for historical reporting. In addition the ATR shall have a Piezo for vehicle classifications and in pavement loop detectors; and

iii. The Developer shall furnish all equipment necessary to achieve a fully-functioning DTD ATR system. The DTD ATR stations consist of loop detector wires and piezoelectric axle sensors (piezo). The loops shall be six feet by six feet, in size and the piezos shall be Class II and be six feet in length. The detector loops shall be six feet by six feet, in each lane, across the General Purpose Lanes and Tolled Express Lanes in both directions.

b. Construction Requirements

The Developer shall furnish all DTD ATR-related equipment and carry out all installation, field-testing, and burn-in of all DTD ATR counting station being replaced. All Construction Work shall be inspected by the Traffic Data Collection Unit (TDC) during installation for Acceptance. The Developer shall test and operate the piezos and loops under actual traffic conditions. A minimum of one month of actual data shall be collected. The volume and vehicle class shall be within ±10 percent for the Site compared to historical data for the test period. There shall be no more than one percent sensor misses in any one lane for the test period. The Developer shall submit all testing and operational data to the Department for Acceptance. The Department shall be responsible for modifying the CTMS software to incorporate these devices.

3.8.12 Doppler Radar

a. Design Requirements

The Doppler Radar are a self-contained unit and there are no design requirements. These units will be reset by banding them to existing poles at the direction of the Department.

b. Construction Requirements

The Developer shall coordinate with the Department if any of the existing Speed Doppler radar units currently installed along the corridor are removed or need to be relocated to new or temporary structures during construction.

3.8.13 Road Weather Information System

a. RWIS are used for traveler information systems and highway maintenance operations by providing on-Site weather information.

b. Design Requirements

i. Three RWIS systems shall be installed as follows:

A. An RWIS will be designed, as two separate units. One unit shall be installed at the east entrance to the Lowered Section and the second unit shall be installed at the west entrance to the Lowered Section, about 500-1,000 feet prior to each respective entrance;

B. An RWIS system shall be installed on the Colorado Boulevard overpass and on the I-70 Mainline, both directions. If this location cannot accommodate both

directions of travel and include the required sensors then it can be broken down into two separate systems; and

C. Salvage from existing RWIS shall be delivered to the Department.

ii. The existing RWIS system near Chambers and I-70 at approximately mile marker 283 will require the roadway pucks to be replaced with non invasive sensors and poles for mounting these; and

iii. The RWIS's shall include the following material requirements:

A. Weather monitoring system, including a remote processing unit, precipitation type sensor, air temperature/relative humidity sensor, ultrasonic wind sensor, non-invasive road surface sensor, non-invasive friction sensor, non-intrusive pavement condition sensor, and a CCTV camera; and

B. Concrete pad and chain link fence.

c. Construction Requirements

The Developer shall be responsible for replacing any portions of the RWIS system impacted by the Construction Work and new installations. An existing RWIS is located at (a) I-70 and mile marker 276 (near SH 2), which shall be salvaged and replaced; and (b) I-70 and mile marker 283 (near Chambers Road), which may] only require puck replacement if damaged.

3.8.14 Enhanced Active Traffic Management Elements

At a minimum, the following enhanced ATM Elements shall be included;

a. Design Requirements

ii. The Developer shall provide lane status information via LUS over each lane (both General Purpose Lanes and Tolled Express Lanes) to Users along the I-70 corridor to notify drivers of Closures, restrictions, maintenance or merge conditions. The lane status information shall be displayed at one-half mile intervals throughout the [corridor][Mainline], starting approximately between Pecos Street and I-225 on the I-70 Mainline for eastbound traffic and approximately between Chambers Road and I-225 on the I-70 Mainline in the westbound direction. The lane status information shall provide continuous visibility of the sequential LUS which can be mounted and combined with other sign structures. The LUS shall be a full-color, full-matrix VMS with a 64 by 64 pixel matrix at 20 mm pixel pitch and utilize a 24 bit red, green, blue color. The viewable area within should be maximized by reducing the bezel width (approximate sign size 60 inches by 60 inches). ATM sign spacing other than 0.5 miles can be proposed in an effort to consolidate and economize static and ATM signing and due to visibility and Manual on Uniform Traffic Control Devices (MUTCD) requirements. However, the ATM spacing must be consistent when physical features do not prevent visibility;

iii. At all LUS locations where full, overhead VMS are not provided, SMVMS shall be installed. These SMVMS shall be full-color, full-matrix, with a minimum pixel matrix of 80 by 80 pixel matrix at 20 mm pixel pitch and utilize 24 bit red, green blue color (approximate size 84 inches by 84 inches). The viewable area within should be maximized by reducing the bezel width. Refer to the Project Special Provisions set out in Appendix A for the specific requirements for each component;

iv. All devices, software, and hardware shall be NTCIP-compliant and compatible with the CTMS. All devices shall be compatible with the ATM software already developed on the US 36 and I-25 North US 36 to 120th corridor and I-70 Peak Period Shoulder Lane. The Developer shall verify that the device is collecting accurate data, that the device is properly communicating with CTMS, that the Department can control the device using CTMS, and verify that the device is powered and functioning properly

and work closely with the Department contract software integrator. The Department shall integrate the ATM devices into CTMS; and

v. LUS must be designed so that they can easily be removed by two people in an overhead lift and this shall include removal and replacement of one LUS in less than 15 minutes from an overhead General Purpose Lane or Tolled Express Lane. The ATM shall be designed to complement the traffic control.

b. Construction Requirements

i. Structure cross sections are required and shall be coordinate with Schedule 10, Section 11 Signing, Pavement Markings, Signalization, and Lighting; and

ii. Refer to Schedule 10, Section 12 Cover MEP System for LUSs and SMVMSs that are to be installed at the Portal and inside the Cover.

3.8.15 Variable Toll Message Signs

The VTMS is a combination of a static sign with one electronic VMS insert that is utilized to display the specific tolls for each segment of the corridor. All I-70 Mainline VTMS shall be located upstream of the Tolled Express Lane ingress/egress point. This will allow Users sufficient time to read the toll rate and then make their decision whether to enter, or continue to use, the Tolled Express Lanes.

a. Design Requirements

i. The Developer shall design a complete VTMS system so that the following requirements are met:

A. VTMS shall be provided prior to each Tolled Express Lane ingress/egress point on the I-70 Mainline, and the VTMS shall be mounted overhead and visible to both Tolled Express Lane and General Purpose Lane Users, including Users that have just entered the facility via entrance ramps; and

B. All VTMS shall be mounted overhead. This includes one VMS insert capable of displaying the toll rates in each overhead sign as required for tolling purposes.

ii. The Developer shall furnish all new VTMS signs and any and all associated equipment necessary to achieve a fully-functioning system. The VTMS signs shall be designed based on the following material requirements, at a minimum:

A. The sign shall utilize LED displays;

B. The overhead signs shall be equipped with the ability to display a minimum of seven characters, including the toll rate, the “$” sign, the numerical value of toll rate, and decimal or the word “CLOSED”; all with a character height of at least 18 inches;

C. Capable of seven characters of text at a height of 18 inch tall characters. The pixel matrix shall be a minimum of 7 by 35;

D. The VTMS shall have a minimum design life of 20 years;

E. The sign viewing angle shall be 30 degrees; and

F. The VTMS cabinet shall be installed on a concrete foundation to the right of the travelled way and shoulder so that maintenance can be performed without the need for lane closures. UPS shall be provided for each VTMS to ensure that each sign is operational for 24 hours in the event of a power failure. The Developer shall purchase and install the UPS in the controller cabinet.

b. Construction Requirements

i. The Developer shall be fully responsible for the furnishing and the installation of all VTMS signs and all damages that occur in the installation and delivery process. The

VTMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available to ensure proper installation and testing. The installation shall include a 60 Calendar Day burn-in of the complete system;

ii. The Department will be responsible for the integration of each new VTMS into CTMS. The ETC System Integrator shall be responsible for incorporating the ETC Elements into their toll collection system;

iii. The Developer shall submit to the Department a VTMS Acceptance Test Procedure for Acceptance according to the manufacturer's recommendations. The test procedure shall be completed in the presence of the Department, the ETC System Integrator, and the manufacturer's representative. The test shall include all items addressed in the Project Special Provisions set out in Appendix A, and all other requirements as stated in the Project Agreement. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Developer shall notify the Department at least 30 Calendar Days prior to the test date; and

iv. A minimum of eight copies of the operations manual detailing the electrical schematics, operation and maintenance of the VTMS system, including spare software copies, shall be provided. One copy of the manual shall remain inside the sign housing or control cabinet. Remaining copies shall be delivered to the Department.

3.8.16 Automatic Vehicle Identification Reader

An AVI reader and antennas shall be installed at each tolling point and used to read the toll tag information stored inside each transponder.

a. Design Requirements

i. The AVI reader shall be installed by the ETC System Integrator in the lane controller cabinet, and the antennas that will read the tag information shall be mounted directly above the Tolled Express Lane. The Developer shall be responsible for providing a structure at each tolling point (either dedicated or shared with another installation) to allow the ETC System Integrator to mount the AVI antennas in the correct positions;

ii. The AVI reader that shall be utilized is anticipated to be a Sirit Model 6204, which shall be installed by the ETC System Integrator. Each tolling point shall require a structure installed by the Developer upon which two antennas per lane, per direction, shall be mounted 17.5 feet above the Tolled Express Lane. The AVI antenna shall be mounted on a two inch diameter pole spanning the Tolled Express Lane that allows for six inches of clearance between the pole and the bottom of the structure for angling and installation of the supporting hardware. In addition, the AVI antenna shall have four feet of lateral clearance. The Developer shall coordinate with the ETC System Integrator to ensure that the proper installation equipment is provided at each AVI antenna installation location;

iii. In addition to the structure, the Developer shall also provide two 2-inch conduits between the lane controller cabinet and the base of the structure supporting the AVI antenna. All cabling shall be installed internal to the structure. Communications to the AVI antenna shall be provided by coaxial cable installed by the ETC System Integrator. The Developer shall ensure that the lane controller cabinet and the structures used to support the AVI antenna equipment be as close together as possible to ensure that the maximum coaxial cable length does not exceed 100 feet; and

iv. The Developer shall be responsible for providing a bracket upon which the ETC System Integrator can mount the AVI antenna. The exact type of bracket will depend

on the type of structure that the AVI antenna shall be mounted on. The Developer shall coordinate with the ETC System Integrator to determine the type and number of brackets that shall be necessary.

b. Construction Requirements

The ETC System Integrator shall be fully responsible for the furnishing and the installation of all AVI antennas and all damages that occur in the installation and delivery process.

3.8.17 Automatic License Plate Recognition Cameras and Loop Detector Wire

The ALPR cameras shall be used to obtain an image of the vehicle's license plate if a transponder is not detected. In-pavement loops shall be used to signal to the ALPR camera that a vehicle is present. Once the image is taken, the Optical Character Recognition (OCR) system inside the camera unit (or the lane controller) will process the image to identify the vehicle's license plate. This information will then be sent to the lane controller.

a. Design Requirements

i. The ALPR cameras and loop detector wire shall be mounted and installed by the ETC System Integrator. The ALPR cameras shall be mounted over each lane. One ALPR camera shall be for front facing license plate photos and one ALPR camera for rear facing license plate photos, The ALPRs shall be mounted over each lane on an overhead structure. The Developer shall be responsible for providing these structures at the toll point locations determined by the ETC System Integrator and the Department for each lane;

ii. In addition to the structure, the Developer shall also provide two 2-inch conduits between the ALPR camera structure and the lane controller. Communications to the ALPR cameras shall be provided and installed by the ETC System Integrator; and

iii. The ALPR cameras shall require an in-pavement loop detection system to signal to the cameras that a vehicle is present. Two loops shall be saw cut into each Tolled Express Lane. The ETC System Integrator shall perform the loop installation and saw cutting, but the Developer shall provide the necessary pull boxes and conduit. The locations of the pull boxes and conduit shall be coordinated with the ETC System Integrator. In addition, the pavement surface temperature must be 50 degrees and rising in order for the ETC System Integrator to properly install the in-pavement loop sealant. As a result, the Developer shall coordinate with the ETC System Integrator to ensure the correct seasonal climate for the in-pavement loop installation.

b. Construction Requirements

The ETC System Integrator shall be fully responsible for the furnishing and the installation of all ALPR cameras and loop detector wire and all damages that occur in the installation and delivery process.

3.8.18 Electronic Tolling Lane Controller

The lane controller shall be located on top of the median barrier at each tolling point and shall be connected to the electronic tolling equipment using two 2-inch conduits. The lane controller will be used for all data processing and transmittal of transponder tag and license plate information via the fiber optic communications network to the ETC back-office for processing.

a. Design Requirements

i. The ETC System Integrator shall be responsible for the installation and configuration of the lane controller; the Developer shall be responsible for the design of the cabinet and associated foundation, the conduit to connect the lane controller to the AVI antenna, ALPR cameras, and transaction status indicator beacon, and the conduit to provide communications and power to the cabinet. One lane controller cabinet will be provided for each tolling point location. The locations of the cabinets, foundations,

and conduits shall be coordinated with, and approved by, the ETC System Integrator. However, the maximum conduit length between the lane controller and the ETC devices (AVI antennas, ALPR cameras, and transaction status indicator beacon) shall not exceed 100 feet; and

ii. The Developer shall have the following responsibilities at each tolling point where a lane controller is required:

A. Provide a 4X NEMA rated cabinet with a minimum size of 48 inches high by 48 inches wide by 24 inches deep. In addition, the Developer shall provide the required foundation on a level surface easily accessible for programming and maintenance purposes;

B. Provide a 12-strand SMFO fiber optic communications lateral between the cabinet and the Department fiber optic backbone. The fiber optic lateral shall terminate at a patch panel that shall be installed inside the communications cabinet; and

C. Provide power to the cabinet to power the lane controller and all associated equipment and provide a UPS for backup power for up to eight hours.

b. Construction Requirements

The ETC System Integrator shall be fully responsible for the furnishing and the installation of all electric tolling lane controller and all damages that occur in the installation and delivery process.

3.8.19 Enforcement Beacons

The enforcement will be on the inside shoulder for enforcement personnel to perform tolling enforcement at each tolling point.

a. Design Requirements

i. An enforcement zone beacon shall be installed with a transaction status indicator to signal to the enforcement personnel whether or not each vehicle was recorded as a single occupancy vehicle (SOV) or high occupancy vehicle (HOV). This beacon shall be furnished and installed by the ETC System Integrator and meet the following material requirements:

A. Provide a blue LED beacon that shall be activated when a User is identified as an HOV by the tag status file;

B. Provide two inch conduit between the beacon and the lane controller for the Developer to connect the two devices;

C. Shall be outdoor-rated and weatherproof; and

D. Shall be visible to enforcement personnel in the adjacent enforcement zone.

b. Construction Requirements

The ETC System Integrator shall be fully responsible for the furnishing and the installation of all enforcement beacons and all damages that occur in the installation and delivery process.

3.8.20 Pull Boxes and Manholes

a. Design Requirements

i. The Developer's design shall utilize fiberglass reinforced, polymer concrete pull boxes and pre-cast concrete manholes with the dimensions of four feet width by six feet length by depth, with a cast iron frame ring and cover. Pull boxes shall be 24 inches by 36 inches minimum for intermediate locations and manholes shall be used for splice locations. 100 feet of fiber optic cable shall be coiled inside each

manhole, and 50 feet of fiber optic cable shall be coiled inside each pull box. Pull box and manhole spacing shall be as follows:

A. The manholes and pull boxes can be clustered in a group in common areas of devices, provided that all fiber optic splicing of ITS devices are performed in manholes;

B. Pull boxes are not allowed in traffic areas, paved shoulders, paved roadways, and sidewalks, no exceptions. No fiber optic splicing shall be performed in pull boxes;

C. The manholes shall be spaced at approximately 1,200 feet as Accepted by the Department; and

D. Pull boxes shall be placed near the ITS and ETC equipment as Accepted by the Department, in safe, easy to access locations.

ii. All pull boxes shall be constructed of fiberglass reinforced, polymer concrete and have a detachable cover with a skid-resistant surface and have the words "CDOTCOMM" cast into the surface. Painting of words shall not be allowed. All pull boxes shall be verified by a third-party nationally recognized Independent Testing Laboratory as meeting all test provisions of ANSI/SCTE 77 2007 *Specification for Underground Enclosure Integrity*, Tier 22 rating.

b. Construction Requirements

The Developer shall furnish and install all pull boxes based on the latest CDOT *Standard Specifications*. Each location shall be easily accessible for maintenance purposes. Pull boxes shall not be placed in a known flood-prone area or drainage ditch. A fiber optic cable label shall be attached to each fiber optic cable located within a pull box.

3.8.21 Cabling and Conductors

a. Design Requirements

i. The Developer shall design conductors and cables utilizing a minimum of #12 AWG for all electrical conductors. All cabling and conductors shall meet the CDOT standards and the National Electric Code (NEC). All electrical items shall be inspected by the state electrical inspector; and

ii. All video-device control cables and connectors shall be designed in accordance with the manufacturer's recommendation and the CCTV manufacturer's signal attenuation requirements.

b. Construction Requirements

All cables shall be installed per the manufacturer requirements for each device or the requirements found in the Project Special Provisions set out in Appendix A. The maximum conduit fill ratio for both new and existing conduits shall be in accordance with the NEC.

3.9 Salvaging of Materials

The Developer shall salvage all existing ITS equipment that is affected by the Construction Work. Salvaged equipment shall be delivered to the Region 1 office located at 18500 East Colfax, Aurora Colorado 80011. The delivery shall be coordinated with the Department 48 hours in advance.

3.10 Integration and Testing

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

a. A new device and/or cabinet supporting the device has been installed;

b. A device and/or cabinet supporting the device has been relocated;

c. The communications path between the devices and the local cabinet has been disturbed and/or relocated; and

d. A new communication path to a device has been established.

3.10.2 The Developer shall be responsible for the installation, communications design, terminations and integration of all ITS devices. This includes all VMS, CCTV cameras, RMS, MVRD, TTI, ATR, RWIS, ATM Elements, LUS, VTMS, and SMVMS. All modifications to the CTMS will be performed by the Department.

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

3.10.4 The Department has testing procedures for certain devices as outlined in the Project Special Provisions, provided in Appendix A. For all other Elements, the Developer shall develop a test plan according to the manufacturer's recommendations for conducting system and subsystem testing and submit it to the Department for Acceptance. No testing shall be performed until the Department has Accepted the test plan. the Department ITS may adjust the proposed testing schedule by up to 30 Calendar Days, at no cost to the Department, to accommodate availability of personnel. The Department staff member or an authorized Department representative will witness and sign off on all tests.

3.10.5 The test plan shall include the following tests:

a. The fiber optic cable testing shall be performed based on the requirements found in the Project Special Provisions, provided in Appendix A;

b. A local field operations test shall be performed for all devices such as for each VMS, SMVMS, RWIS, CCTV, MVRD, TTI, ATR, ATM, and LUS to demonstrate that all hardware, cables, and connections furnished and installed by the Developer operate correctly and that all functions are in accordance with the requirements described herein. Verify the power supply voltages and the functionality of the cabinet fans and heaters. Provide the Department a 30 Calendar Day pretest notification and test completion notification. In addition, the Developer shall prepare a CDOT Device Data Sheet for each installed device and submit to the Department for Acceptance;

c. A subsystem communication throughput test over the communication path between each field device and the communications hub. The testing shall occur after all communication installation for a particular site has been completed, the communication paths between the device and the communications hub have been functional for at least 48 hours, and all fiber optic tests have been successfully passed. Notify the Department at least 30 Calendar Days prior to beginning testing;

d. After successful completion of all subsystem test procedures and after all I-70 Mainline lanes, as well as ramps are open, test each site for proper communication operation for 90 Calendar Days. During the testing period, all equipment at the site that was provided, installed, or relocated by the Developer shall operate without failures of any type. If any component malfunctions or fails to provide the capabilities specified herein during the 90 Calendar Day test period, within 72 hours of notification by the Department, troubleshoot to find the exact cause of the failure. The cost of correcting equipment malfunctions shall be the responsibility of the Developer. After the component malfunction has been corrected to the satisfaction of the Department, restart the 90 Calendar Day test period; and

e. For all components which integrate with the toll system, a toll system connectivity test shall be conducted in coordination with the ETC System Integrator.

3.10.6 Documentation indicating successful passing of each test shall be submitted to the Department for Acceptance.

3.11 Training and Documentation

The Developer shall provide the Department with instruction in the operation and maintenance of the hardware and software associated with the ITS equipment and infrastructure. The Developer shall also provide documentation for all ITS equipment.

3.12 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance or Acceptance in accordance with the specified timeframes:

Table 3-1 Deliverables

Deliverable	Information, Acceptance, or Acceptance	Schedule
ITS and ETC Equipment	Acceptance	30 Calendar Days after issuance of NTP 2
Conduit Duct Bank Plans	Acceptance	30 Calendar Days after issuance of NTP 2
Node at I-70 and Airport Blvd Plans	Acceptance	30 Calendar Days after issuance of NTP 2
Electrical Power conduit and plans	Acceptance	30 Calendar Days after issuance of NTP 2
Location of ITS and ETC Elements	Acceptance	30 Calendar Days after issuance of NTP 2
Test Plan for ITS and ETC equipment	Acceptance	30 Calendar Days after issuance of NTP 2
Signing plans for VMS, SMVMS, VTMS, LUS and static signs (ATM)	Acceptance	30 Calendar Days after issuance of NTP 2
CCTV, MVRD, TTI, ATE, RWIS Plans	Acceptance	30 Calendar Days after issuance of NTP 2
AVI, ALRP, enforcement beacons, loop detector (ETC Plans)	Acceptance	30 Calendar Days after issuance of NTP 2
Fiber allocations, splicing diagrams and network drawings with all Elements included (network plans)	Acceptance	30 Calendar Days after issuance of NTP 2
VMS Acceptance Test Procedure	Acceptance	30 Calendar Days after issuance of NTP 2
VTMS Acceptance Test Procedure	Acceptance	30 Calendar Days after issuance of NTP 2
DTD ATR Testing and Operational Data	Acceptance	30 Calendar Days after issuance of NTP 2
CDOT data collection worksheet for each ITS and ETC piece of equipment	Acceptance	30 Calendar Days after issuance of NTP 2
Successful toll system connectivity test documentation	Acceptance	30 Calendar Days after issuance of NTP 2

3.13 Appendices

Appendix A Project Special Provisions

Appendix B Responsibility Matrix

Appendix A
Project Special Provisions for ETC and Tolling Equipment Elements

The following special provisions supplement or modify the *Standard Specifications* and take precedence over the *Standard Specifications* and plans. The provisions of Appendix A to Schedule 10A Applicable Standards and Specifications apply to these Project Special Provisions.

PROJECT SPECIAL PROVISIONS

REVISION OF SECTION 604
MANHOLE (TRAFFIC MANAGEMENT SYSTEM)

Section 604 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

Traffic Management System (TMS) manhole shall include the installation of manholes for the Traffic Management System at locations shown on the plans, or as approved by the Engineer.

MATERIALS

Manhole (TMS) shall be pre-cast concrete, circular or square as shown on the plans, with a base and cast iron frame ring and cover. Each manhole, frame, and cover shall conform to American Association of State Highway and Transportation Officials (AASHTO) HS20-44. Manholes shall be capable of accepting concrete grade rings to add height to raise the ring and cover to a future finished grade.

Pre-cast units shall be provided with factory-installed knockouts that will permit the installation of a minimum of six two-inch conduits. The factory-installed knockouts shall be at a depth of three feet below the top of the manhole. The manhole shall have a detachable cover that has a skid-resistant surface and have the words “CDOT COMM” physically impressed on its top. The cover shall be attached to the manhole body by screw-in bolts.

Each Manhole shall include all hangers and hooks that accommodate all proposed fiber and communication cabling. Fiber management hangers and hooks for fiber coils and splice canisters shall be of sufficient quantity to hang each backbone and lateral cable installed in the manhole separately on its own set of hangers.

CONSTRUCTION REQUIREMENTS

The contractor shall neatly excavate the site of manhole installation. A minimum of 12 inches of ¾ inch granite-gravel shall be placed below the manhole.

In pavement and sidewalks, the top of the manhole shall be flush with the existing grade. Outside of pavement and sidewalks, the top of the manhole shall be two inches above existing grade.

Backfill around the manhole excavation shall conform to Section 206, Structure Backfill (Class 2).

Fiber optic cable coils shall be tied to each cable rack with plastic cable ties. The Contractor shall coil the fiber cable per the manufacture’s recommendations. If hangers are not factory installed in the manhole, the bolts shall be installed in the manhole walls by means of either an epoxy compound or expansion type fitting. Conduit that enters the manhole base shall have sweeps attached so conduit entrance is elevated a minimum of six inches above the bottom of the manhole. .Installation of the manhole shall conform to details shown on the Plans.

METHOD OF MEASUREMENT

Manhole (TMS) will be measured by the complete unit in place and accepted by the Engineer. Terminating conduits inside the manholes shall be included in the cost of this item. Marking conduit ownership in each manhole by the Contractor shall be included in the cost of this item and not paid for separately. Manhole (TMS) shall include, but not be limited to, the manhole, excavation and backfill,

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REVISION OF SECTION 604
MANHOLE (TRAFFIC MANAGEMENT SYSTEM)

hooks to hang coils, all cable innerduct, conduit inside manhole, all hardware, as well as all equipment and labor necessary to install the manhole per these Special Provisions. Capping and sealing the conduits shall be included in the cost of the conduit.

REVISION OF SECTION 612
LOCATION MARKERS

Section 612 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

Contractor shall furnish and install location markers for identifying fiber optic conduit and other utility conduit 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 from -40º F to 175º F. In some instances when markers are installed on National Forest Service Lands the location marker shall be brown (Federal Standard Color 20059 or approved by Project Engineer) in color.

The Location Marker (Fiber Optic) (Dome) 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 mile. This label shall be placed below the "FIBER OPTIC CABLE" warning label. When markers are installed on National Forest Service Lands the dome marker label shall have black lettering on a brown (Federal Standard Color 20059 or approved by Project Engineer) background. The Contractor shall provide the label submittal to the Project Engineer.

Location Marker (Utility) (Flat Slat) shall be made of fiberglass reinforced composite, and shall be orange or red in color. The marker shall retain dimensional stability in temperatures ranging from -40º F to 175º F. In some instances when markers are installed on National Forest Service Lands the location marker shall be brown (Federal Standard Color 20059 or approved by Project Engineer) in color.

The Location Marker (Utility) (Flat Slat) shall include a label with CDOT contact information and the designation of "ELECTRICAL CABLE" or "TELEPHONE CABLE". The label shall have black lettering on a red background for electrical and black lettering on an orange background for telephone. In some instances when markers are installed on Forest Service Lands the flat marker label shall have black lettering on a brown (Federal Standard Color 20059 or approved by Project Engineer) background. The Contractor shall provide the label submittal to the Project Engineer for approval

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

CONSTRUCTION REQUIREMENTS

Location Marker (Fiber Optic) (Dome) shall be installed at all Pull Box and Manhole (TMS) locations that contain fiber optic cable. Intermediate markers shall be installed at 1000 foot spacing along the each conduit run.

Location Marker (Utility) (Flat Slat) shall be installed at utility pull box and 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.

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REVISION OF SECTION 612
LOCATION MARKERS

METHOD OF MEASUREMENT

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

REVISION OF SECTION 613
ELECTRICAL CONDUCTOR IDENTIFICATION

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

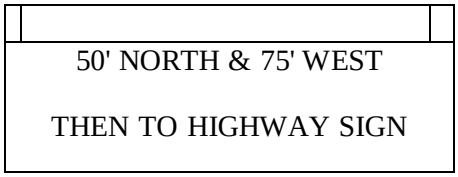
Section613.08 shall include the following:

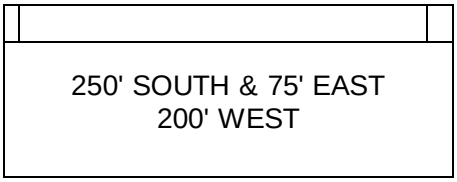
All electrical conductors shall be tagged as follows:

Electrical conductor cable tags shall be located below the termination in the base of the street light, in the pull box, in the pedestal and at the point of termination to existing facilities of the Local Utility Company supplying electrical service. The tags shall be attached with a cable tie. The information written on the tag shall include the direction and approximate length of cable feeds running from where to, etc.

Each incoming conductor shall be individually color coded with 1 tape mark, while outgoing conductors shall have 2 tape marks.

Example:





Uniform tags are available in a Tag Kit. The Tag Kit consists of: 100 tags, 3 part yellow with 1 hole, 100 black nylon ties and 1 black sharpie pen.

Size	2-1/2" X 5"
Standard Package	Kit
Weight, Kit, Approx.	1.5 Pounds
Color	Yellow

REVISION OF SECTION 613
ELECTRICAL CONDUIT

Section 613 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work includes furnishing and installing new High-Density Polyethylene (HDPE) and Polyvinyl Chloride (PVC) electrical conduit and fittings for use with fiber optic cable, electrical conductors, and communications cabling.

MATERIALS

All materials furnished, assembled, fabricated, or installed under this item shall be new, Underwriters Laboratories (UL) listed, corrosion resistant and National Electric Code (NEC) compliant. Materials shall be submitted to the Project Engineer for approval.

Electrical conduit shall be Schedule 80 in the diameters, quantities and depths shown on the plans. Electrical conduit and fittings shall be UL listed.

HDPE conduit and fittings shall be certified by the manufacturer as meeting American National Standards Institute (ANSI) ANSI/UL 651A. PVC conduit and fittings shall be certified by the manufacturer as meeting ANSI/UL 651. The manufacturers shall be International Organization for Standards (ISO) ISO 9001 compliant.

All HDPE conduit shall be factory lubricated, low-friction, high-density conduit constructed of virgin high-density polyethylene resin. HDPE conduit shall be capable of being coiled on reels in continuous lengths, transported, stored outdoors, and subsequently used for installation, without affecting its properties or performance.

Each conduit shall be equipped with a pull tape. The pull tape shall have a minimum tensile strength of 1800 pounds and be of a design and manufacture that prevents cutting or burning into the conduit during cable installation. The pull tape shall include a continuous 22 gauge tracer wire. Splices in the pull tape and tracer wire may occur inside manholes and pull boxes and shall not be permitted inside conduit.

A minimum 12 gauge tracer will shall be included in conduits containing fiber optic cable.

CONSTRUCTION REQUIREMENTS

All conduit and fittings installation shall conform to the NEC.

Electrical Conduit (Bored) shall be HDPE and installed using a trenchless technology such as 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.

Prior to construction, the Contractor shall submit a trenching and boring plan to the Engineer for approval. The plan shall show the limits of the planned work areas and the areas of anticipated disturbance. All disturbances outside the planned work areas created by Contractor's operations shall be restored to their original condition at the Contractor's expense.

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REVISION OF SECTION 613
ELECTRICAL CONDUIT

During construction operations, the contractor shall maintain boring logs that include the depth at specific distances along the bore. Boring logs shall be submitted on a weekly basis.

Excavations and conduit installation shall be performed in a continuous operation. All trenches shall be backfilled by the end of each shift. 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 Contractor shall be responsible for damage due to over-excavating a trench and heaving damage to the existing asphalt and concrete mat, caused by equipment directly and by dislodging rocks or boulders. All damage from over-excavation and heaving shall be repaired at the Contractor's expense. The Contractor shall bear the cost of backfilling all over-excavated areas with the appropriate backfill material approved by the Engineer.

The Contractor shall restore all surface materials to their original condition or better, including but not limited to pavement, sidewalks, sprinkler systems, landscaping, shrubs, sod, and native vegetation that is disturbed by the conduit installation operation. All repairs shall be included in the cost of the conduit.

The Contractor shall use UL listed splice couplings that comply with the NEC. All associated work to splice the conduit shall be included in the cost of the item. The coupling technology used to connect conduit ends shall require no special tools and form a watertight, airtight seal. The breaking force between segments shall exceed 250 pounds. Conduit splices shall be kept to a minimum and all such locations shall be approved and inspected by the Engineer and the authority having jurisdiction. Additional pull boxes shall not be substituted for conduit splices.

Conduit plugs that are watertight, removable, mechanical and equipped with a tie rope for connection to a pull rope and pull tape shall be supplied and installed in all open conduit ends as soon as the conduit is installed. Conduit shall be plugged at termination points such as pull boxes, manholes, controller cabinets and node buildings. Conduits containing cable shall be plugged with durable and reusable split type plugs, fabricated without metallic parts. The plugs shall allow easy removal and reinstallation around in-place cables. Split type plugs shall provide a watertight and airtight seal of at least 22 pounds per square inch. They shall be installable by hand without using tools and without damaging the cable. All plugs shall be correctly sized to fit the conduit being plugged.

All conduits shall use sweeps to elevate the buried conduits to the final grade within a pull box or manhole, as shown on the plans. The sweeps shall be terminated within the pull boxes and manholes to allow for easy installation and removal of conduit plugs. The sweeps shall be set above the ground surface of the inside of the pull box at a height that does not interfere with coiling of the fiber optic cable.

All conduit runs containing fiber optic cable shall have a limited number of bends. The sum of the individual bends on a single conduit run between any two pull points shall not exceed 270 degrees. No individual bend shall exceed 90 degrees. All conduit bends shall have a minimum acceptable radius of 48 inches for 90 degree bends and for conduit containing fiber optic cable and 24 inches for all other bends. HDPE conduit minimum bending radius shall conform to Table 354.24 in the NEC.

New conduits may be installed into existing pull boxes, manholes and cabinet bases, and the Contractor shall carefully excavate around the existing facility and install the new conduit as shown on the plans. The Contractor shall not damage the existing facility or its contents. If the existing conduit, pull box, lid

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REVISION OF SECTION 613
ELECTRICAL CONDUIT

and concrete collars are damaged during conduit installation, the Contractor shall restore the damaged item or section to current CDOT requirements at no additional cost to the project.

Conduit shall always enter a pull box, manhole, cabinet base and all other structure types from the direction of the run only.

All conduits ends shall be free from sharp edges and burrs.

METHOD OF MEASUREMENT

Electrical Conduit will be measured by the actual linear foot of conduit installed and accepted.

Conduit shall also include all groundwork, lubricants, anchors, bands, skids, sweeps, pull rope, pull tape, copper tracer wire, adaptors, fittings, splice couplings, conduit plugs, foam sealant, installation equipment, mounting brackets and hardware, structure anchors, adhesives, labor and all other items necessary to complete the work.

REVISION OF SECTION 613
PULL BOXES

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

Contractor shall furnish and install fiberglass reinforced polymer concrete pull boxes and concrete aprons at locations shown on the plans.

MATERIALS

Pull boxes shall be verified by a 3rd Party Nationally Recognized Independent Testing Laboratory as meeting all test provisions of American National Standards Institute/Society of Cable Telecommunications Engineers (ANSI/SCTE) 77, 2013 Specification for Underground Enclosure Integrity, Tier 22 rating. Pull boxes shall be Underwriters Laboratories (UL) listed. Certification documents shall be submitted with material submittals.

Each pull box shall have a locator disk manufactured into the lid for communication line locating. The locator disk shall be compatible with a CDOT cable locator.

Pull boxes 24 inches by 36 inches and larger shall have removable split lids with a removable metal center support brace. Lid segment weight shall not exceed 100 pounds.

Pull box removable lids shall be provided with a skid-resistant surface and have the words “CDOT FIBER”, “EMS MARKER EMBEDDED IN COVER” and the tier level rating cast into the surface. Painting of words shall not be accepted. The cover shall be attached to the pull box body by means of 3/8 inch x 7 inch lag thread hex head stainless steel bolts.

Each lid shall have two lift slots. Lift slots shall be rated for 3000 pounds.

Test point locations shall be integrated into the pull box lids to provide for attachment of test leads of various connector types for underground conduit tracing. The minimum number of test point locations shall equal the number of conduit banks entering the pull box, up to a maximum of five test points. Pull boxes with split lids shall have the test points on one split lid section only. Pull box lids shall be furnished with 3/8 inch x 1/16 inch deep recesses at locations adjoining each test point for the application of direction arrow symbols indicating the direction of underground conduit exiting the pull box. Recesses shall be thoroughly cleaned with alcohol prior to applying arrow symbols.

Wire mesh shall be installed in a manor to completely surround the box. The wire mesh shall meet the material standard ANSI/American Society of Testing and Materials (ANSI/ASTM) A555-79 and made of T-304 stainless steel, 0.025 inch wire diameter minimum and shall have a spacing of 10 mesh per inch.

Pull boxes installed in dirt or landscaped areas shall have a Class B concrete apron or a pre-cast polymer concrete apron. Class B concrete shall be in accordance with Section 601.

The pre-cast polymer concrete apron shall be non-metallic, non-conductive, and UV resistant, and shall include two lifting slots for placement in the field. The pre-case polymer concrete apron shall be a minimum 4 inches deep and shall extend 11 inches (minimum) from each side of the pull box. The gap between the pre-cast polymer concrete apron and outer wall of the pull box shall be a maximum of ½ inch.

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REVISION OF SECTION 613
PULL BOXES

Pull Box (Surface Mounted) shall be aluminum type with a hinged front door and have at least a National Electrical Manufacturers Association (NEMA) 3R rating. The hinged door shall be provided with both a weather tight seal and an aluminum hasp. Surface mounted pull boxes shall be of the dimensions shown on the plans.

CONSTRUCTION REQUIREMENTS

A minimum of 12 inches of ¾ inch granite-gravel shall be installed as a base for the pull box. The 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 granite-gravel to alleviate future settling.

Wire mesh shall be installed in 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 inch 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 through at the bottom of the box. All openings cut in the wire mesh that are larger than the diameter of the conduit shall be covered with additional wire mesh in a manner to completely surround the pull box with wire mesh.

Tracer wire shall be attached to the trace test points on the underside of the pull box lid. Each trace wire shall be attached to an individual trace point, no two wires shall be attached to the same point. The Contractor shall coil an additional 6 feet of tracer wire inside the pull box to ensure that the tracer wire will not disconnect from test points when the lids are removed.

At pull boxes installed in dirt and landscaped areas, the Contractor shall install a concrete apron or a pre-cast polymer concrete apron around the edges of the pull box. Three sides of the concrete apron shall measure 12 inches wide by 6 inches deep and one side shall measure 18 inches wide by 6 inches deep. The apron side measuring 18 inches wide by 6 inches deep shall be located on the edge of the pull box furthest from the roadway, and shall contain a 4 inch diameter round knockout for fiber optic marker installation. Pull boxes shall not be installed above the grade of the apron. The concrete apron shall have a 1 percent slope away from the top of pull box to allow for drainage.

Pull Box (Surface Mounted) shall be mounted on or embedded into hard surfaces such as bridge decks, concrete barriers, retaining walls, or buildings, as shown on the plans. Surface mounted pull boxes shall be attached using 3/8 inch epoxy anchors or other methods approved by the Engineer. Surface mounted pull boxes shall not be used for ground installations. Pull rope and tracer wire shall be installed in surface mounted pull poxes.

METHOD OF MEASUREMENT

Pull Boxes will be measured by the actual number installed and accepted, and will include base, lid, integrated location disk, integrated test points, arrow symbols, excavation, backfill, concrete apron, wire mesh and 3/4 inch 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.

REVISION OF SECTION 613
ELECTRICAL CONDUIT (LIQUIDTIGHT FLEXIBLE METAL)

Section 613 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work includes furnishing and installing new liquidtight flexible metal conduit (LFMC) and fittings for use with fiber optic cable, electrical conductors and communications cabling. All underground-to-aboveground and aboveground conduit installations shall utilize liquidtight flexible metal conduit as indicated on the Plans.

MATERIALS

All materials furnished, assembled, fabricated, and installed under this item shall be new, Underwriters Laboratories (UL) listed, corrosion resistant, and National Electric Code (NEC) compliant.

LFMC shall meet UL safety standard UL 360 –*Liquid-Tight Flexible Metal Conduit*.

The LFMC shall be rated for use in wet locations.

For below ground to above ground transitions, LFMC to Polyvinylchloride (PVC) coupling and LFMC to High Density Polyethylene (HDPE) coupling shall be listed for use.

CONSTRUCTION REQUIREMENTS

Prior to installation, the contractor shall submit technical data sheets for all conduit types, couplings, fittings, elbows, L-bends, mounting hardware, conduit plugs, and sealing plugs to the Engineer for written approval.

LFMC shall be installed in all below ground to above ground conduit transitions. Below ground, the contractor shall couple the LMFC conduit to the below ground conduit using approved coupling technology that is listed for use with LFMC.

Above ground LFMC shall be installed between pole-mounted communications cabinets and device poles. LFMC shall be installed between Variable Message Sign (VMS) housing and the VMS support structure. For above ground LFMC entries into cabinets, poles, and VMS housings, the contractor shall use fittings listed for use with LFMC. At entries into cabinets, poles, and VMS housings, the Contractor shall ensure that the entry hole is free from sharp edges and burrs.

The Contractor shall use factory drilled entries for connection of LFMC to cabinets, poles, and VMS housings. If the LFMC is to be used on an existing structure or cabinet on which no factory drilled entry exists, the Contractor shall receive approval from the Project Engineer prior to field drilling cabinets, poles, and VMS housings.

At field drilled steel poles, the Contractor shall repair all damaged galvanizing by hot dip or metallizing process as described in American Society for Testing and Materials (ASTM) ASTM A780 or shall paint with one full brush coat of a zinc-rich paint meeting Military Specification Department of Defense (DOD) DOD-P-21035A. Spray can applications of zinc will not be allowed.

LFMC installation shall conform to the requirements of NEC Article 350 LFMC.

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REVISION OF SECTION 613
ELECTRICAL CONDUIT (LIQUIDTIGHT FLEXIBLE METAL)

LFMC shall be secured and supported per NEC Article 350.30.

METHOD OF MEASUREMENT

Electrical Conduit (Liquidtight Flexible Metal) will be measured by the linear foot of complete conduit installed in accordance with the Plans.

REVISION OF SECTION 613
SERVICE METER CABINET

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

Subsection 613.01 shall include the following:

This work consists of the installation of a Service Meter Cabinet including the preformed polymer concrete footing, meter cabinet, mounting hardware, Cabinet mounting base, power cables, UV-resistant cables and connection to the power source and all required wires and wiring to facilitate a fully functioning service meter Cabinet at locations as shown on the plans.

Add subsection 613.09 (a) as follows:

(a) *Service Meter Cabinet*

The Service Meter Cabinet shall be NEMA 3R and shall be UL 508 listed as industrial control panel service equipment. It shall have the ability to be padlocked at the location shown on the Service Meter Cabinet detail.

Utility metering compartment shall be protected with a hinged, pad lockable hood.

Service conductor terminations shall be accessible by a removable cover.

The Service Meter main shall be 100 amp minimum, with voltage range of 120V – 480V.

The Service Meter Cabinet shall be compatible with both ringless and ring-type meter sockets, and with 4-7 terminals.

Exterior of the Service Meter Cabinet shall be a gray powder-coated aluminum, with a thickness of 0.125 inches which is rain and dust impermeable and electrically welded and reinforced where required.

The Service Meter Cabinet shall have a swing dead front door compartment with distribution and control equipment that is secured with both a latch and a pad lockable draw latch outer door.

All nuts, bolts, screws and hinges shall be stainless steel and not visible from outside the meter Cabinet.

Service Meter Cabinet and polymer concrete foundation shall have a divider to separate the service and load conduits/ conductors.

The Service Meter Cabinet shall provide accommodation for four, single branch circuit breakers at a minimum, not including the main breaker. Circuit breakers shall be cable-in, cable-out with line on top, and load on bottom. Handle position shall be up = ON, down = OFF.

The polymer concrete foundation shall have 1/2 inch-13 unified course (UNC) through bolt inserts for mounting the Service Meter Cabinet.

The polymer foundation shall pass the most recent addition of the ANSI/SCTE 77 6.0, 6.1, 6.2, 6.3, 6.4 & 6.5 environmental test, including a five percent solution of magnesium chloride.

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REVISION OF SECTION 613
SERVICE METER CABINET

The divider plate between the service conduit and load conduit shall be full depth of foundation and be made of preformed polymer concrete.

All materials furnished, assembled, fabricated or installed shall be new, corrosion resistant and in strict accordance with the details shown on the Service Meter Cabinet detail and in these Technical Specifications.

Functional Characteristics:

The Service Meter Cabinet shall provide a viewing window in which the meter shall be readable while providing a vandalism resistant enclosure. Viewing window shall be comprised of bullet resistant polycarbonate resin thermoplastic.

Physical Characteristics:

Refer to the Service Meter Cabinet detail for specific dimensions and tolerances.

CONSTRUCTION REQUIREMENTS

Add Subsection 613.03(a), Service Meter Cabinet:

The Contractor shall go through the Colorado State Electrically Board to acquire the electrical installation permit prior to the installation of the meter Cabinet equipment for all CDOT owned and maintained traffic signal and lightning.

Installation shall conform to the latest edition of the National Electrical Code (NEC) and the Authority Having Jurisdiction.

The Service Meter Cabinet foundation shall be polymer concrete with fiberglass reinforcement. The pad shall be continuous cloth reinforcement on the inside and outside perimeters.

The Service Meter Cabinet shall be factory wired and inspected by the Engineer prior to installation.

Construction methods shall conform to the requirements of Section 614.10 (c), Section 614.10 (d) and Section 614.10 (j).

The Contractor shall certify the records of the testing including grounding, voltage drop (within 3 percent) and other required tests as meeting specification requirements and submit the records to the Engineer.

Subsection 613.11 shall include the following**:**

Service Meter Cabinet payment will include the foundation, all internal wiring, hardware, polymer foundation, excavation, meter, back fill, disposal of excess excavation, crushed rock, UNC inserts and everything shown on Meter Cabinet Detail excluding the conduit.

REVISION OF SECTION 614
DYNAMIC MESSAGE SIGN (COLOR LED) (OVERHEAD)

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing overhead, walk-in accessible Dynamic Message Signs (DMS), sign controller, and associated uninterruptible power supply (UPS) system, DMS equipment cabinet and cabinet foundations at locations shown in the plans. The sign shall be fully compatible with the mounting hardware and support structure shown on the plans. The DMS shall be equipped with the ability to display 3 lines of text at a height of 18-inch tall characters and 18 characters per line, and shall have a display made up of a full color matrix configuration. The DMS shall be equipped to display 24 bit color messages and graphics using red green and blue Light Emitting Diodes (LEDs). The sign shall have 32-35 mm pixel spacing. The color LEDs shall have a viewing angle of 30 degrees. The sign shall include a main service power shut off mounted to the sign structure. The sign shall be capable of operating without any decrease in performance over a temperature range of -34° F to +140° F with a relative humidity of 0 to 99 percent, non-condensing. The UPS system shall be capable of running essential sign control electronics, communication equipment, and half of the pixels in the LED sign face allowing messaged display, and sign communication/control for up to 8 hours depending on the number of batteries used.

MATERIALS

a. *Certifications.* Prior to start of the installation of the DMS the Contractor shall provide the following certifications to the Engineer for review and approval:

1. Certification showing that the manufacturer of the DMS is fully compliant with ISO 9001 as of the bid date for this project. The ISO 9001 Certification shall apply to the facility, and to the design, fabrication, installation, and maintenance of the DMS. The facility where this company actually designs and manufactures the DMS shall be ISO 9001:2000 (or later) certified a minimum of one year prior to the bid date for this project.

2. Working drawings showing the sign housing and brackets shall be sealed by a Professional Engineer of Record. The sign housing shall be capable of withstanding a wind loading of 120 mph without permanent deformation or other damages. The sign housing shall also be designed and PE sealed to withstand current AASHTO specified group loading combinations.

3. Certification showing that welding of the DMS housing is in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The DMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the ANSI/AWS D1.2-97 Structural Welding Code for Aluminum.

4. Certification that all aluminum face materials have a coating that meets or exceeds the requirements of the American Architectural Manufacturers Association (AAMA) Specifications Publication No. 2605.

5. Certification that the LEDs were tested and binned in accordance with the CIE Test Method A.

6. Documentation and information on software as described in Appendix A of this document.

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REVISION OF SECTION 614
DYNAMIC MESSAGE SIGN (COLOR LED) (OVERHEAD)

7. Documentation verifying the DMS is listed by an accredited 3rd party testing organization for conformance to UL48 and UL 1433.

8. All workmanship shall comply with IPC-A-610C, Class 2 titled "Acceptability of Electronic Assemblies",

9. Documentation providing proof PCB silicon conformal coating conformance to IPC-CC-830.

10. Documentation that the sign's structural integrity is in conformance with the current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals.

11. Documentation that the DMS conforms to the Transient Protection and Vibration of the NEMA Standard TS4, Section2.

b. *Sign Housing.* All component parts shall be easily and readily accessible by a single person for inspection and maintenance. There shall be room for a technician to work. Access shall be made by entering both sides of the housing. The housing shall be weather tight, and compliant to the NEMA 3R Standard. The bottom panel of the housing shall have a minimum of four drain holes, with snap-in, drain filter plug inserts.

The sign housing shall be capable of withstanding a wind loading of 120 mph without permanent deformation or other damages. The sign housing shall also be designed, stamped and signed by a Professional Engineer to withstand current AASHTO specified group loading combinations including: sign weight, repair personnel and equipment, ice and wind loads. It shall also meet strength requirements for truck-induced gusts as specified in NCHRP Report 412. The sign housing shall be engineered to withstand snow loading of 40 pounds per square foot, as well as the ability to be mounted in a manner that prevents the buildup of snow and creates a natural means by which snow can run off without impeding flow of traffic. The performance of the sign, including the visibility and legibility of the display, shall not be impaired due to continuous vibration caused by wind, traffic or other factors. The housing shall be designed to accommodate mounting on the rear vertical plane and shall be structurally sufficient to be mounted to the sign support structure. The sign housing and structural components for the tilting system including bolts and welds, shall be structurally sufficient to perform under all applicable loading conditions including gravity, wind, traffic, weather, roadway deicers, maintenance, and other environmental factors.

All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The exterior front face surfaces shall be finish coated by a system that meets or exceeds the AAMA Specification No. 2605. The finish shall be matte black. The main body of the sign housing shall be constructed of aluminum. All exterior seams shall be continuously welded by an inert gas process, except for the coated fascia material.

Each panel shall have a single polycarbonate sheet attached securely to the inside of the aluminum panel. The polycarbonate sheet shall cover all of the pixel openings. The polycarbonate shall be

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REVISION OF SECTION 614
DYNAMIC MESSAGE SIGN (COLOR LED) (OVERHEAD)

sealed to prevent water and other elements from entering the DMS. The polycarbonate shall contain UV inhibitors that protect the LED display matrix from the effects of ultraviolet light exposure and prevent premature aging of the polycarbonate itself. The use of a plastic lens system will not meet the requirements and will be cause for rejection. No louvers shall be allowed.

Polycarbonate sheets shall have the following characteristics:

- Tensile Strength, Ultimate: 10,000 PSI
- Tensile Strength, Yield: 9,300 PSI
- Tensile Strain at Break: 125%
- Tensile Modulus: 330,000 PSI
- Flexural Modulus: 330,000 PSI
- Impact Strength, Izod (1/8", notched): 17 ft-lbs/inch of notch
- Rockwell Hardness: M75, R118
- Heat Deflection Temperature Under Load: 264 PSI at 270F and 66 PSI at 288F
- Coefficient of Thermal Expansion: 3.9X10-5 in/in/F
- Specific Heat: 0.30 BTU/lb/F
- Initial Light Transmittance: 85% minimum
- Change in Light Transmittance, 3 years exposure in a Southern latitude: 3%
- Change in Yellowness Index, 3 years exposure in a Southern latitude: less than 5%

LED display modules shall mount to the inside of the DMS front face panels and be accessible from the inside of the sign housing only. No tools shall be needed for removal and replacement of LED display modules.

The external front face panels shall have the following minimum dimensions: The perimeter panels shall be a minimum of 12 inches wide. The external front face panels shall be thermally insulated from the rest of the sign housing. The glazing, aluminum mask and the external front face panels shall be easily replaceable from within the sign housing.

The ventilation system shall be forced air. The system shall be designed to adequately cool the pixels from all sides along with the front and rear of the display module and all other internal components. The ventilation system shall have the following properties:

(1) Positive pressure (exhaust fans are not acceptable).

(2) The fans shall have ball or roller bearings, shall be permanently lubricated and shall require no periodic maintenance. The fans are to be positioned in such a manner so as to provide a balanced air flow to the ventilation system in the event of failure of any fan.

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REVISION OF SECTION 614
DYNAMIC MESSAGE SIGN (COLOR LED) (OVERHEAD)

If internal components in the sign are capable of operating within the required ambient temperature range without ventilation, no ventilation system is required.

Access door shall be mounted to an integral doorframe, which mounts to the DMS housing using non-corrosive hardware. A continuous vertical stainless steel hinge shall support the door, and the door shall open outward towards the monotube structure. In the closed position, each door shall latch to its frame with a three-point draw- roller mechanism. The latching mechanism shall include an internal handle and release lever. Door release levers shall be located so that a person with no key and no tools cannot become trapped inside the housing.

Access doors shall be framed and swing open and lock in-place open at a 90 degree angle and 110 degree angle from the DMS housing end wall. The bottom edge of each door shall be at least 3.5-inches from the bottom edge of the DMS housing. This will provide clearance for the doors to swing open over external access platform.

The door will be fitted with an interior and exterior lockable heavy duty handle. Each Exterior door shall be furnished with a handle that is pad lock ready. Each door shall close around its flanged frame and compress against a closed-cell foam gasket, which adheres to the door. All doors shall contain a stop that retains the door in a 90 and 110-degree open position. When a door is open, the door and its stop shall withstand damaged by a 60 mph wind gust.

The DMS must be equipped with an OSHA compliant safety rail assembly, which when closed across an open access door, prevents service personnel from falling out of the DMS. DMS shall have a rail assembly to be provided for each door in the display. The rail assembly shall require no tools to open and close.

The door shall incorporate an open/closed sensor that is detectable by the sign controller and notifies the Central system control software whenever the door is accessed.

Minimum headroom of 72-inches shall be provided in the DMS housing. This free space shall be maintained across the entire width of the DMS housing, with the exception of structural frame members. Structural members shall be designed not to obstruct the free movement of maintenance personnel throughout the DMS interior.

A level aluminum walkway shall be installed in the bottom of the DMS housing. The walkway shall be a minimum of 24-inches wide and it shall run the entire length of the housing, from access door to access door. The walkway's top surface shall be non-slip and shall be free of obstructions that could trip service personnel. The walkway shall support a load of 300 pounds per linear foot.

The internal structural members shall be extruded aluminum and shall accommodate both the display module mountings while allowing air distribution. The display modules shall be removed and replaced without the use of tools and without disturbing adjacent modules. The sign shall have heaters that are sufficient to elevate the temperature within the sign to 30° F above the temperature outside the sign. These heaters shall be controlled by a manually operated automatic shut-off timer in the sign and remotely from central computers.

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REVISION OF SECTION 614
DYNAMIC MESSAGE SIGN (COLOR LED) (OVERHEAD)

The system power and communication lines shall each be protected by two stages of surge protection devices. The first stage shall be an arc discharge, gas discharge tube or a thyristor surge protection based unit with local and remote reporting capability. The second stage shall be metal oxide varistor (MOV) based. This second stage shall include a crowbar circuit, that when remotely enabled, shall trip the power circuit breaker when the second stage surge suppressor is activated. In both cases, tripping of each stage (or both if tripped simultaneously) of the surge protection and shall report the power surge condition to the sign controller for report to central. The crowbar shall be an option that is either enabled or disabled and is selected and downloaded from the central system control software to the sign controller. When this option is enabled, tripping of the second stage of surge protection shall prevent power from reaching any components of the sign until the surge protection has been replaced. When this option is disabled, the sign will continue to function normally after the second stage of surge protection is tripped.

c. *Sign controller*. The sign controller and associated communication equipment shall be installed inside the DMS equipment cabinet. Each DMS shall be controlled and monitored by its own sign controller. The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with DMS control software in order to perform most DMS control functions.

The sign controller shall meet the following operational requirements:

- Communicate using embedded NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with graphical VFD or LCD and keypad for direct operation and diagnostics as described herein
- Contain a minimum of three (3) NTCIP-compliant RS232 communication ports
- Contain a minimum of one (1) NTCIP-compliant Ethernet port with RJ45 connector
- Contain a minimum of one (1) NTCIP-compliant RS422 communication port with RJ45 connector
- Have the ability to play volatile messages
- Contain DMS-specific control firmware (embedded software) that shall monitor all external and internal sensors and communication inputs and control the display modules as directed by external control software and the front panel interface
- Ability for remote firmware upgrades that error check to eliminate firmware corruption

NTCIP shall be natively supported in the DMS controller. External protocol converter or translator devices shall not be allowed.

The sign controller shall be programmed to receive and transmit NTCIP compliant sign control commands from the central system control software and laptop computer.

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The controller shall have power-up and auto-restart capabilities with programmable default actions when recovering from a power off condition. A hardware watch dog circuit shall provide automatic reset of the controller and communications device. Central control shall have ability to perform a remote command for the controller and communications device reset. The controller shall be able to accept standard UPS shutdown commands via Ethernet or serial interface.

The Controller shall perform all communication, control and feedback functions and shall not require an intermediate control device and be the only sign controller. Communication and control lines between the sign controller and the system interface circuits shall be opto-coupled

d. *Cabinet.* The sign controller shall be installed in the DMS Equipment Cabinet (Type 2). The cabinet shall be a Model 332D cabinet with dual-sided access, polycarbonate base and cast-in-place concrete pad.

The equipment cabinet shall be natural aluminum with anchor bolts in accordance with the FHWA-IP-78-16 specification. The cabinet shall include the following minimum requirements:

- Two (2) internal (front/back) fluorescent lamps
- Full-height standard Electronics Industry Alliance (EIA) 19-inch rack with a minimum of one (1) pullout drawer
- Power panel board circuit breakers meeting the following minimum requirements
- Service entrance-rated
- Minimum of 12 circuit breaker mounting positions
- Short circuit rating of 22,000 amps for main and 10,000 amps branch circuits
- Underwriters' Laboratories (UL) Listed
- Two (2) 15-amp National Electrical Manufacturers Association (NEMA) 15-R 120VAC duplex outlet with one (1) ground-fault circuit interrupter.
- One (1) earth ground lug that is electrically bonded to the cabinet.
- One (1) thermostatically controlled 100 cubic feet per minute (cfm) exhaust fan mounted near the top of the cabinet.
- Filtered air intake ports with removable and replaceable fan and filter located on the bottom third of each access door.
- Remote communication device.

A 19-inch rack mountable power conditioner shall be installed in the DMS Equipment Cabinet to provide – simultaneously- fully regenerated, conditioned power with true sine wave and continuous AC outputs to controllers, and communication devices.

The following shall be mounted inside the cabinet:

1. NTCIP compliant DMS controller

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2. Fold-down laptop shelf and document holder for maintaining sign.

3. Ruggedized EtherNet switch or router with fiber uplink port and optics appropriate to the distance to the communications hub. The switch or router shall be capable of operating within the temperature range given for the DMS or have sufficient ventilation to stay within its manufacturer's specified temperature range. Adequate ports for system devices shall be provided plus at least two spare 100 Mbs ports.

4. Display system interface circuits

5. Local/remote control switch

6. RS-232 cable (a minimum of 4 feet long to connect the controller interface to a laptop computer) (7) A.C. surge protection and communication surge protection.

e) *Electronics.* All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods.

All printed circuit boards shall be sealed with a silicone conformal coating.

Components shall be arranged so they are easily accessible for testing and replacement. All circuit designs shall utilize high quality electronic components and shall provide a meantime before failure of at least 3 years.

The DMS shall contain an automatically controlled defog system that warms the DMS front face when the internal DMS relative humidity is near condensation levels. This system shall keep the front face polycarbonate panel free of fog and condensation. The heat generated by the defog system shall not damage any part of the DMS.

The sign and the controller shall be capable of operating with 120/240 VAC, 50 amp per leg, 60 Hz, single phase power. The sign shall have a power panel board with 50-amp two-pole breaker (common trip) main, 120/240

VAC, single phase, four wire load center with 20 circuit capability. Each circuit in the sign shall be powered from a circuit breaker. Inside the sign housing, all 120 VAC service lines shall be independently protected by a thermo magnetic circuit breaker at the sign housing entry point. All 120 VAC wiring shall be located in conduit, pull boxes, raceways, or control cabinets as required by the National Electrical Code (NEC). No 120 VAC wiring shall be exposed within or outside of the sign housing. The sign housing shall not be considered as a raceway or control cabinet. There shall be a minimum of three GFI Duplex outlets installed inside the sign housing.

The DMS housing shall contain a minimum of one (1) compact fluorescent light (CFL) fixture for every eight (8) feet of DMS housing width. The lamps shall be evenly spaced across the housing ceiling and provide uniform light distribution for maintenance purposes. The light provided by the lamps shall meet the requirements of *ANSI/IESNA RP-7-01, Lighting Industrial Facilities*. Each lamp shall be rated for at least 10,000 hours of operation, have a minimum 30-watt rating, be self -

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ballasted, and be rated for cold weather operation down to -20º F. Lamp housing shall be heavy duty and enclosed to protect the lamps from damage. The lamps shall and have a color temperature of at least 4100ºK.

The brightness and color of each pixel shall be uniform over the entire face of the sign within the 30-degree cone of vision from minimum of 200 feet up to and including 1100 feet in all lighting conditions.

Sign brightness shall meet NEMA TS4-2005, Section 5, (12,400 cd/m2 minimum white brightness). The LED drive current shall be less than 30mA for Red and less than 15mA for Blue and Green.

The brightness of each LED shall be measured in accordance with CIE Test Method A, as described in CIE 127-

1997, Technical Report: Measurement of LEDs.

Each LED module shall contain a printed circuit board to which LED pixels are soldered. The LED pixel matrix shall conform to the following specifications:

- Each LED module shall contain approximately 256 LED pixels configured in a two dimensional array.
- The pixel array shall be approximately sixteen (16) pixels high by sixteen (16) pixels wide.
- The distance from the center of one pixel to the center of all adjacent pixels, both horizontally and vertically, shall be 32-34 mm.
- Each pixel will contain a Red, Green, and Blue LED, each being independently driven.
- The failure of an LED string or pixel shall not cause the failure of any other LED string or pixel in the DMS.
- The base of the discrete LEDs shall be soldered such that the 30 degree field of view is consistent with field of view for the entire set of LEDs on the sign.
- All LED pixel boards shall be identical and interchangeable throughout the DMS.

Discrete LEDs

DMS pixels shall be constructed with discrete LEDs manufactured by a reputable manufacturer such as Avago Technologies (formerly Agilent Technologies), Nichia Corporation, OSRAM or EOI. Discrete LEDs shall conform to the following specifications:

- All LEDs shall have a nominal viewing cone of 30 degree angle of 15 degrees measured from the center of the longitudinal viewing cone.
- Color LEDs shall utilize AlInGaP semiconductor technology and shall emit light that has a peak wavelength of 590 □ 5 nm. Color LEDs shall utilize Red AlInGaP 626 nm, Green InGaN 525 nm and Blue InGaN 470 nm.

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- The LED packages shall be fabricated from UV light resistant epoxy.
- The LED manufacturer shall perform intensity sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive luminous intensity "bins" as defined by the LED manufacturer.
- The LED manufacturer shall perform color sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive color "bins" as defined by the LED manufacturer.
- The various LED color and intensity bins shall be distributed evenly throughout the sign and shall be consistent from pixel to pixel. Random distribution of the LED bins shall not be accepted.
- The LED manufacturer shall assure color uniformity and consistency on the LED display face within the 30 degree cone of vision and shall not have inconsistent color shifts.
- LED package style shall be surface-mount or through-hole with or without standoffs.
- All LEDs used in all DMS provided for this contract shall be from the same manufacturer and of the same part number, except for the variations in the part number due to the intensity and color.
- The LEDs shall be rated by the LED manufacturer to have a minimum lifetime of 100,000 hours of continuous operation while maintaining a minimum of 70% of the original brightness.

Pixel Drive Circuitry

Each LED display module shall contain electronic driver circuitry that shall individually control all pixels on that module. The driver circuitry shall conform to the following specifications:

- Each LED module shall be microprocessor-controlled and shall communicate with the sign controller on a wire or fiber optic communication network. The microprocessor shall process commands from the sign controller to display data, perform diagnostic tests, and report pixel and diagnostic status.
- The LED driver shall compensate for color based on temperature and LED color changing characteristics.
- Constant current LED driver ICs shall be used to prevent LED forward current from exceeding the LED manufacturer's recommended forward current whenever a forward voltage is applied. To maximize LED service life, LED drive currents will not be allowed that exceed the manufacturer's recommendations for the 100,000-hour lifetime requirement.
- The LED driver shall utilize PWM (Pulse Width Modulation) of the drive current to vary the output intensity of each LED. The drive current pulse shall be modulated at a frequency high enough eliminate visible flickering from zero to full-brightness.

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- The LED driver circuitry shall receive updated display data at a minimum rate of ten (10) frames per second from the sign controller. Each LED driver circuit shall be powered by external regulated DC power supplies.
- The voltage of each power input shall be measured to the nearest tenth of a volt and reported to the sign controller upon request. Each driver circuit shall also contain a status LED for the power source that indicates if the power source is present or not.
- The LED driver circuitry shall be able to detect that individual LED strings or pixels are stuck off and shall report the pixel status to the sign controller upon request.
- The LED driver circuit shall contain a seven segment numeric LED display that indicates the functional status of the LED pixel display module. At a minimum, it shall indicate error states of the LED pixels and communication network. The indicator shall be positioned such that a maintenance technician can easily view the status code for diagnostic purposes. The LED display module shall report the status, including pixel errors, voltage levels, etc to the sign controller upon request.

Pixel power drawn from the DC supplies shall not exceed 1.5 watts per pixel, including the driving circuitry.

A minimum of three photocells shall be installed on the sign. These devices shall permit automatic light intensity measurement of light conditions at each sign location. These photocells shall be mounted in a manner to measure front, rear and ambient light conditions.

Provisions shall be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

The sign shall be configured such that a UPS will be able to run all necessary control electronics, communication equipment, and the half of the pixels in the sign display in the event of a power failure.

Power supplies for the sign display shall be configured such that the failure of any one supply does not degrade functionality of the display and the display remains 100% functional.

All cables shall be securely clamped/tied in the sign housing. No adhesive attachments will be allowed.

The signs shall be capable of displaying ASCII characters 32 through 126 (including all upper and lower case letters and digits from 0 to 9) at any location in a message line.

The Contractor shall be responsible for locating the nearest electrical power and telephone sources and connecting those sources to the appropriate terminations with the DMS. The Contractor shall cooperate with the local electrical and telephone utilities to establish a service accounts at the direction of the Engineer.

f) *Control and Communication.* The sign controller shall be capable of being controlled from the central system control software via RS-232 serial and Ethernet communications.

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The communications between the sign controller and the central system control software shall comply with the NEMA National Transportation Communications for ITS Protocol (NTCIP). The sign controller shall support all NTCIP conformance levels, conformance groups, objects, and minimum storage sizes and ranges as specified in APPENDIX A.

In addition to the standard Management Information Base (MIB) objects, the sign shall include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined in this specification and in APPENDIX A.

Protect low voltage communication lines (twisted pair or coaxial) with multi-stage one- pair or two-pair surge suppressors designed for high-exposure applications, providing common mode and differential mode protection, with a maximum clamping voltage of 10 volts greater than peak DC or maximum AC RMS signal voltage and peak surge current rating of 10kA.

The sign controller shall be capable of being remotely reset from the central system control software.

The sign shall provide a minimum of four (4) input and four (4) output contact closures able to receive digital and or analog signals that allow at least 15 message activations upon contact closure events. These message activations shall permit standard NTCIP operations to occur and also permit contact closure messages to occur without message activation collisions and or message activation errors. Contact closures shall be remotely accessible using standard NTCIP MIB objects. Contact closures shall be capable of issuing NTCIP traps.

The sign controller shall allow user-configuration of maximum and minimum temperature in which to turn fans on and off.

The sign shall have polling capability and at a minimum shall be capable of reporting the status of the following:

1. Pixel operational status that includes the state of every pixel

2. Sign and ambient temperature

3. DC power supply status

4. The current state (on or off) of each pixel, including any pixel errors, in the actual, currently displayed message without disturbing the message in any way. This shall be real time and shall not be based on a previous pixel test.

5. Cooling fan status

6. Access door alarm

7. Communication failure log

8. UPS status

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9. AC surge protector status

The controller software shall be capable of displaying the following types of messages:

1. Static messages capable of displaying any character or set of characters

2. Full Graphic capabilities.

3. Flashing messages with the following ranges of adjustable timing:

   (a) Message time on from 0.5 to 5.0 seconds in 0.1 second increments.

   (b) Message time off from 0.5 to 5.0 seconds in 0.1 second increments.

4. Alternating messages capable with the following ranges of adjustable timing:

   (a) Primary message time on from 0.5 to 5.0 seconds in 0.1 second increments.

   (b) Primary message time off from 0 to 5.0 seconds in 0.1 second increments.

   (c) Alternate message time on from 0.5 to 5.0 seconds in 0.1 second increments.

   (d) Alternate message time off from 0 to 5.0 seconds in 0.1 second increments.

5. Capability to do Text rectangles, Background colors, Foreground Colors, Support 24 Bit Color Scheme as specified by NTCIP 1203 v2

It shall be possible to flash any character or set of characters in an alternating message at the adjustable frequencies listed above for flashing messages. The flashing period shall be a sub-multiple of the associated alternating on time. It shall also be possible to flash any character or set of characters in a static message. The sign controller shall monitor the photo cell circuits in the sign and convert the measured light intensity into the desired pixel brightness.

e) *UPS System.* The UPS system shall provide "On-Line" dual conversion control.

The UPS shall be rated per the following:

Input Voltage	85 VAC to 135 VAC
Input Frequency	48 to 62 Hz
Output Voltage	120 VAC +/- 3%
Output Frequency	60 Hz
Power	VA required to run color DMS sign control electronics, communication equipment, and half of the pixels in the LED sign face, allowing for sign functionality during a power outage.

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The unit will be designed for a hot swap of components and shall not compromise existing DMS wiring. The unit shall provide for RS232 communication and contact closures for alarm functions. The unit shall be temperature rated to operate from 0 degree C to +40 degree C.

The UPS system shall be capable of producing simultaneously-fully regenerated, conditioned power with true sine wave and continuous AC outputs with stand by capability.

The unit shall have a re-settable power event counter to record the number of power utility failures, a battery run- time counter and temperature compensated battery charging.

The UPS System shall be capable of providing continuous, fully conditioned (both voltage and frequency), regulated, sinusoidal (AC) power to selected devices such as controllers, modems, 5 volt power supplies, and sign face drivers.

Wiring shall comply with national electrical code (NEC) standards and approved wiring methods. Properly rated SO/SJO cords shall be allowed to allow easy replacement of the UPS System.

The UPS shall be 19-inch rack mountable and shall be accompanied with 19-inch rack mountable aluminum battery shelves for installation in the DMS Equipment Cabinet (Type 2).

The UPS shall consist of two major components, the Electronics Module and the Battery System.

1. The Electronics Module shall consist of the following:

   A. True Sine wave, high frequency inverter.

   B. Minimum 3-stage, temperature compensated, battery charger

   C. For connection from the Electronics Module to the Battery System, a dedicated harness shall be provided with quick-release, keyed, circular connectors, and braided nylon sleeving over all conductors.

   D. Local and remote control of UPS functions

   E. Local and remote communications capabilities

2. The Battery System shall consist of the following:

   A. Shall meet up to 8 hour requirement to run sign electronics, communication equipment, and half of the pixels in the sign face with all LEDs illuminated at daytime brightness levels.

   B. The batteries shall be comprised of extreme temperature, deep cycle AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid) batteries that have been field proven and tested by the U.S. military.

   C. Batteries shall be certified to operate at extreme temperatures from -40’C to +74’C.

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D. The batteries shall be provided with appropriate interconnect wiring and a corrosion-resistant mounting trays and/or brackets appropriate for the location into which they will be installed.

E. The interconnect cable shall be protected with abrasion-resistant nylon sheathing.

F. Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells and heavy-duty plates to withstand shock and vibration.

The UPS System shall come standard with software, RS232 interface via a DB-9F connector (optional SNMP Adapter for TCP/IP protocols) allowing full, interactive, remote computer monitoring and control of the UPS functions. The software shall allow the user to set up all operational parameters either locally or remotely and test the functionality of the unit.

The UPS Alarm Function Monitoring shall come standard with a DB-9F connector with open collectors (40 V @ 20 mA) indicating:

- Loss of Utility Power
- Inverter Failure
- Low Battery

The UPS Front Panel Controls shall come standard with Power ON, Cold (DC) Start, Alarm Silence, Battery Test, Bypass Breaker and DC/Battery Breaker.

Reliability shall be calculated with mean time between failure (MTBF) of 100,000 hours based on component ratings.

The DMS Equipment Cabinet (Type 2) shall be used to house the UPS system along with the equipment for the overhead DMS and lane use control signals.

MANUFACTURER QUALIFICATIONS

The manufacturer shall supply experience documentation showing that the manufacturer has been in business, under the current corporate name, designing and manufacturing Interstate DYNAMIC MESSAGE SIGN (COLOR LED) (OVERHEAD)s for a minimum of 5 years; and that the manufacturer has in operation a minimum of 50 walk-in DMSs 1 of which being COLOR DMSs and NTCIP compliant.

WARRANTY

The Contractor shall ensure that the manufacturer can warranty the sign and sign controller for a minimum of 3 years for all parts returned to the factory, and full telephone technical support at no additional charge to the Department. The technical support shall include access to a trained service representative who can respond within 24 hours to questions related to all DMS related equipment problems and maintenance issues.

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The UPS equipment shall include a minimum two year warranty on parts and labor. Batteries shall include a minimum two year pro rated warranty. Vendor shall be responsible for processing warranty repairs.

A repair option shall be available for UPS equipment no longer covered by the warranty period. Repair cost shall include all labor and materials necessary to complete the repair. Vendor shall be responsible for processing non- warranty repairs.

CONSTRUCTION REQUIREMENTS

Dynamic Message Sign

Contractor shall be fully responsible for the delivery of the DMSs and sign controllers to the installation site and any damages that occur in the installation delivery process.

The DMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on site to ensure proper installation and testing.

The Contractor shall perform a DMS acceptance test procedure for approval and acceptance by the Department in the presence of the Engineer, a representative of the CDOT Colorado Transportation Management Center and the

Manufacturer's representative. The test shall include all items addressed in these specifications and any other requirements from the project plans or Engineer. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Contractor shall notify the Engineer at least two weeks prior to the test date.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the DMS system, including spare software copies, shall be provided. Additional copies may be requested by the Engineer. One copy of the manual shall remain inside the sign housing or control cabinet. One copy shall be mailed to the Colorado Transportation Management Center at 425 C Corporate Circle, Golden, Colorado 80401.

The Manufacturer shall provide 8 hours of class room training for CDOT at the CTMC in Golden, CO. The Manufacturer shall supply 8 hours of on-site training in the sign for the CTMC staff.

Uninterruptible Power Supply System

The UPS and batteries shall be installed in the DMS Equipment Cabinet (Type 2) which shall also house control equipment for lane use control signals and side-mounted variable message signs. Contractor shall provide detailed design and installation plans for Engineer approval prior to installation. Power feeding the sign shall first terminate in the ground mounted cabinet. Non-UPS power shall pass through the cabinet to power non-UPS loads. Power required for sign backup shall feed through the UPS system. A bypass switch, rated for the designed system, shall be installed to bypass the UPS in the event of UPS failure or for system maintenance. A disconnect switch shall also be installed to disconnect UPS and line power from the sign. The Contractor shall install the DMS UPS output into the DMS power distribution panel per sign manufacture recommendations. Serial and Ethernet cables shall be installed from the UPS system

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ground cabinet to the sign communication device location. All wiring shall conform to the latest version of the NEC.

The UPS equipment shall include a minimum two year warranty on parts and labor. Batteries shall include a minimum two year pro rated warranty. Vendor shall be responsible for processing warranty repairs.

A repair option shall be available for UPS equipment no longer covered by the warranty period. Repair cost shall include all labor and materials necessary to complete the repair. Vendor shall be responsible for processing non- warranty repairs.

Testing

A local field operations test shall be performed to demonstrate that all hardware, cables, and connections furnished and installed by the Contractor operate correctly and that all functions are in accordance with the requirements described herein. The power supply voltages and the functionality of the cabinet fans and heaters shall be verified. The contractor shall provide CDOT a 5-Day pretest notification and test completion notification. In addition, the Contractor shall prepare a Device Data Sheet for each installed device and submit to CDOT.

A subsystem communication throughput test over the communication path between each field device and the communications hub shall be performed. The testing shall occur after all communication installation for a particular site has been completed, the communication paths between the device and the communications hub have been functional for at least 48 hours, and all fiber optic tests have been successfully passed. The Contractor shall notify CDOT at least 7 Days prior to beginning testing.

After successful completion of all subsystem test procedures and after all mainline lanes as well as ramps are open, each site shall be tested for proper functionality and device availability for 30 consecutive Days. During the testing period, all equipment at the site that was provided, installed, or relocated by the Contractor shall operate without failures of any type. If any component malfunctions or fails to provide the capabilities specified herein during the 30- Day test period, within 48 hours of notification by CDOT, the Contractor shall troubleshoot to find the exact cause of the failure. The cost of correcting equipment malfunctions shall be the responsibility of the Contractor. After the component malfunction has been corrected to the satisfaction of CDOT, the 30-Day test period shall be restarted.

A CDOT staff member or an authorized CDOT representative shall witness and sign off on all tests.

METHOD OF MEASUREMENT

Dynamic Message Sign (Color LED) (Overhead) will be measured by the actual number of signs that are installed, tested and accepted and shall include all labor, materials, and equipment necessary to complete the work at each installation site, including delivery of all equipment and cabinets to the installation site; installation of sign controller, controller interface cabinet; auxiliary control panel, sign housing, and all associated electronics, communications equipment, UPS system, DMS equipment cabinet (Type 2), and wiring; all tests as described herein; and standard warranty;.

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All costs associated with furnishing, delivery to the site, and installation of DMS Equipment Cabinet (Type 2) and associated cabinet foundation will not be paid for separately, but shall be included in the work at each site.

All costs associated with furnishing and installing the power panel board, including making all associated electrical connections within the DMS housing will be measured and paid for by Pay Item, "Branch Circuit Panel (Special)".

All costs associated with furnishing, installing and making all electrical connections for the main service power disconnect located on the sign structure near the access control cabinet will be measured and paid for by Pay Item, "Safety Switch, NEMA 3R, 30A, 2-Pole, 240V, (For Variable Message Sign Maint Disconnect)".

All costs associated with having a manufacturer's representative on-site will not be measured and paid for separately, but shall be included in the work.

All costs associated with training and the purchasing of manuals will not be measured and paid for separately, but shall be included in the work.

All costs associated with the delivery of the sign to the installation site will not be measured and paid for separately, but shall be included in the work.

Appendix A

NTCIP Requirements

This portion of the specification defines the detailed NTCIP requirements for the LED DMS covered by the project specifications. This specification references several standards through their NTCIP designated names. The following list provides the full reference to the current version of each of these standards. In many cases, the standard is more widely known by its original NEMA assigned number, in these cases, the NEMA number is also identified. The content of the NEMA standard is identical to that of the NTCIP standard.

Each NTCIP Component covered by these project specifications shall implement the most recent version of the standard that is at the stage of Recommended or higher as of the contract bid date, including any and all Approved or Recommended Amendments to these standards as of the same date. It is the ultimate responsibility of the vendor to monitor NTCIP activities to discover any more recent documents.

General Requirements:

Subnet Level
NTCIP Components may support additional Subnet Profiles at the vendor's option. At any one time, only one Subnet Profiles shall be active on a given serial port of the NTCIP Component. If the NTCIP

Component has a serial port that supports multiple Subnet Profiles, the NTCIP Component shall be configurable to allow the field technician to activate the desired Subnet Profile and shall provide a visual indication of the currently selected Subnet Profile.

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Transport Level
Each NTCIP Component shall comply with NTCIP 2202, (NEMA TS 3.Internet). NTCIP Components may support additional Transport Profiles at the manufacturer's option. Response datagrams shall use the same Transport Profile used in the request. Each NTCIP Component shall support the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

Application Level
Each LED DMS shall comply with NTCIP 2301, (NEMA TS 3.AP-STMF), as a Managed Agent and shall meet the requirements for Conformance Level 1 (NOTE – See Amendment to standard). Simple network management protocol (SNMP) shall be required and simple transportation management protocol (STMP) shall not be required. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Responses shall use the same Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

Information Level
Each NTCIP Component shall provide Full, Standardized Object Range Support of all objects required by these procurement specifications, unless otherwise indicated below. The maximum Response Time for any object or group of objects shall be 200 milliseconds.

The vendor's software shall implement all mandatory objects of the mandatory conformance group defined in NTCIP 1201, (NEMA TS 3.4) Global Object Definitions:
Configuration Conformance Group – Section 3.1
Security Conformance Group (new in Amendment 1)

The vendor's software shall implement the mandatory objects of the optional conformance groups defined in NTCIP 1201, (NEMA TS 3.4), Global Object Definitions:
Time Management Conformance Group – Section 3.3
TimeBase Event Schedule Conformance Group – Section 3.4
Report Conformance Group – Section 3.5

The vendor's software shall implement all mandatory objects of all mandatory conformance groups defined in NTCIP 1203, (NEMA TS 3.6) Object Definitions for DYNAMIC MESSAGE SIGN (LED) (OVERHEAD)s:
Sign Configuration Conformance Group – Section 4.1
Message Table Conformance Group – Section 4.6
Sign Control Conformance Group – Section 4.7

The vendor's software shall implement all mandatory objects of the optional conformance groups defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for DYNAMIC MESSAGE SIGN (LED) (OVERHEAD)s:
GUI Appearance – Section 4.2
Font Definition – Section 4.3
DMS Sign Configuration – Section 4.4
MULTI Configuration – Section 4.5
Default Message – Section 4.8
MULTI Error – Section 4.10

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Illumination/Brightness – Section 4.11
Scheduling – Section 4.12
Auxiliary I/O – Section 4.13
Sign Status – Section 4.14
Status Error – Section 4.15
Pixel Error Status – Section 4.16
Fan Error Status – Section 4.18
Temperature Status – Section 4.17

The vendor's software shall implement the following optional objects defined in NTCIP 1203, (NEMA TS 3.6):

dmsMessageBeacon – Section 2.6.1.1.1.8.6
dmsSWReset – Section 2.7.1.1.1.1
dmsMessageTimeRemaining – Section 2.7.1.1.1.4
dmsShortPowerRecoveryMessage – Section 2.7.1.1.1.8
dmsLongPowerRecoveryMessage – Section 2.7.1.1.1.9
dmsShortPowerLossTime – Section 2.7.1.1.1.10
dmsResetMessage – Section 2.7.1.1.1.11
dmsCommunicationsLossMessage – Section 2.7.1.1.1.12
dmsTimeCommLoss – Section 2.7.1.1.1.13
dmsPowerLossMessage – Section 2.7.1.1.1.14
dmsEndDurationMessage – Section 2.7.1.1.1.15
dmsMultiOtherErrorDescription – Section 2.7.1.1.1.20
dmsStatDoorOpen – Section 2.11.1.1.1.6
fanFailures – Section 2.11.2.1.1.8
fanTestActivation – Section 2.11.2.1.1.9
tempMinCtrlCabinet – Section 2.11.4.1.1.1
tempMaxCtrlCabinet – Section 2.11.4.1.1.2
tempMinAmbient – Section 2.11.4.1.1.3
tempMaxAmbient – Section 2.11.4.1.1.4
tempMinSignHousing – Section 2.11.4.1.1.5
tempMaxSignHousing – Section 2.11.4.1.1.6

The vendor's software shall implement the following tags (opening and closing where defined) of MULTI as defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for DYNAMIC MESSAGE SIGN (LED) (OVERHEAD)s:

MULTI Tag

1 Field
2 Flash
3 Font
4 Hexadecimal Character
5 Justification Line
6 Justification Page
7 Moving Text
8 New Line
9 New Page

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REVISION OF SECTION 614
DYNAMIC MESSAGE SIGN (COLOR LED) (OVERHEAD)

10 Page Time
11 Spacing – Character

The Field Tag shall support the following field ID's:

Field Tag ID	Description
1	1 Time, 12-hour format (no AM/PM indicator)
2	2 Time, 24-hour format
3	3 Temperature in degrees Celsius
4	4 Temperature in degrees Fahrenheit
5	7 Day of week
6	8 Day of month
7	9 Month of year
8	10 Year, 2-digits
9	11 Year, 4-digits

Sizes and Ranges

All objects required by these procurement specifications shall support all values within its standardized range. The standardized range is defined by a size, range, or enumerated listing indicated in the object's SYNTAX field and/or through descriptive text in the object's DESCRIPTION field of the relevant standard. The following provides the current listing of known variances for this project:

Object	Reference	Minimum Project Requirements
NTCIP 1201 (TS 3.4)		
moduleTableEntry	2.2.3	Shall contain at least one row with module Type equal to 3 (software). The module Make shall specify the name of the manufacturer, the module Model shall specify the manufacturer's name of the component and the model Version shall indicate the model version number of the component.
communityNamesMax	2.8.2	Shall be at least 4.
maxTimeBaseScheduleEntries	2.4.3.1	7
maxDayPlans	2.4.4.1	7
maxDayPlanEvents	2.4.4.2	7
maxEventLogConfigs	2.5.1	50
eventConfigMode	2.5.2.3	2,3,and 4
maxEventLogSize	2.5.3	200
maxEventClasses	2.5.5	7
maxGroupAddress	2.7.1	1
NTCIP 1203 (TS 3.6)		
dmsNumPermanentMsg	2.6.1.1.1.1	50
dmsMaxChangeableMsg	2.6.1.1.1.3	50
dmsFreeChangeableMemory	2.6.1.1.1.4	50KB
dmsMaxVolatileMsg	2.6.1.1.1.6	50

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DYNAMIC MESSAGE SIGN (COLOR LED) (OVERHEAD)

dmsFreeVolatileMemory	2.6.1.1.1.7	50KB
dmsMsgMultiString	2.6.1.1.1.8.3	See attached table
dmsControlMode	2.7.1.1.1.1	2,4,5
numFonts	2.4.1.1.1.1	4
maxFontCharacters	2.4.1.1.1.3	127
DMSCharacterHeightPixels	2.3.1.1.1.1	5
DMSCharacterWidthPixels	2.3.1.1.1.2	7
DMSSignHeightPixels	2.3.1.1.1.3	3
DMSSignWidthPixels	2.3.1.1.1.4	10
DMSHorizontalPitch	2.3.1.1.1.5	70mm
DMSVerticalPitch	2.3.1.1.1.6	70mm
defaultBackgroundColor	2.5.1.1.1.1	0 (black)
defaultForegroundColor	2.5.1.1.1.2	9 (amber)
defaultJustificationLine	2.5.1.1.1.6	2,3,4
defaultJustificationPage	2.5.1.1.1.7	2,3,4
defaultFlashOn	2.5.1.1.1.3	0.5 to 5.0
defaultFlashOff	2.5.1.1.1.4	0.5 to 5.0
defaultPageOnTime	2.5.1.1.1.8	0.5 to 5.0
defaultPageOffTime	2.5.1.1.1.9	0.5 to 5.0
defaultCharacterSet	2.5.1.1.1.10	eightBit (2)
numActionTableEntries	2.9.1.1.1.1	15

Documentation

Software shall be supplied with full, electronic documentation containing American Standard Code for Information Interchange (ASCII) versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.
- If the device does not support the full range of any given object within a Standard MIB Module, a vendor specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro. The filename of this file shall be identical to the standard MIB Module, except that it will have the extension ".man".
- A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

The vendor shall allow the use of any and all of this documentation by any party authorized by CDOT for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR TOLL EQUIPMENT

DESCRIPTION

This work consists of furnishing and installing a rack mounted Uninterruptible Power Supply (UPS), batteries, transfer switch, disconnect switch, and power connections in a Contractor supplied Model 332 cabinet, side mounted cooling fan and polycarbonate base at locations shown in the plans. The UPS system shall be capable of running essential control electronics, communications equipment, AVI Antennas, Cameras, transaction beacons, and other miscellaneous equipment as noted in the Toll Layout Details, for at least 8 hours. The dual toll layout location at Station 116+75 shall also be powered by one UPS system and 332 Cabinet for up to 8 hours. The distance from the UPS to the control cabinet is approximately 110' for all toll layouts and this should be a consideration for power loss. The Toll equipment cabinet is located in the median and the UPS and cabinet is located outside of the roadway clear zone.

The UPS system shall be designed for a hot swap of components and shall not compromise existing operation of dynamic message signs or variable message signs. The unit shall provide for RS232 communication and contact closures for alarm functions.

MATERIALS

The UPS system shall provide "On-Line" dual conversion control. The UPS shall be rated per the following:

Input Voltage	85 VAC to 135 VAC line in neutral and 192VAC to 264VAC line to line
Input Frequency	48 to 62 Hz
Output Voltage	120 VAC +/- 3%120/240 VAC, 1-Phase, 3 Wire plus Ground, +/- 3% Output
Frequency 60 Hz	
Power	VA required of running the toll equipment for a single and multi-direction toll point for up to 8 hours, based on 20 amps VA need.

The unit shall be temperature rated to operate from 0 degree C to +40 degree C.

The UPS system shall be capable of producing simultaneously-fully regenerated, conditioned power with true sine wave and continuous AC outputs with stand by capability.

The unit shall have a re-settable power event counter to record the number of power utility failures, a battery run-time counter and temperature compensated battery charging.

The UPS System shall be capable of providing continuous, fully conditioned (both voltage and frequency), regulated, sinusoidal (AC) power to selected devices such as controllers, modems, and 5 volt power supplies, and sign face drivers.

Wiring shall comply with national electrical code (NEC) standards and approved wiring methods. Properly rated SO/SJO cords shall be allowed to allow easy replacement of the UPS System.

The interconnect cable shall be protected with abrasion-resistant nylon sheathing.

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR TOLL EQUIPMENT

The UPS shall consist of two major components, the Electronics Module and the Battery System.

A. The Electronics Module shall consist of the following:

1. True Sine wave, high frequency inverter.

2. Minimum 3-stage, temperature compensated, battery charger

6. For connection from the Electronics Module to the Battery System, a dedicated harness shall be provided with quick-release, keyed, circular connectors, and braided nylon sleeving over all conductors.

7. Local and remote control of UPS functions

8. Local and remote communications capabilities

B. The Battery System shall consist of the following:

1. Shall meet the continuous 8 hour requirement to run sign electronics, communication equipment, and half of the sign face with all LEDs illuminated at daytime brightness levels.

2. The batteries shall be comprised of extreme temperature, deep cycle AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid) batteries that have been field proven and tested by the U.S. military.

3. Batteries shall be certified to operate at extreme temperatures from -40’C to +74’C.

4. The batteries shall be provided with appropriate interconnect wiring and a corrosion-resistant mounting trays and/or brackets appropriate for the location into which they will be installed.

5. Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells and heavy-duty plates to withstand shock and vibration.

C. The UPS enclosure shall have forced air Cooling/Ventilation:

1. The UPS shall be forced air cooled by internally mounted, continuous fans.

2. Fan power shall be provided from the internal DC supply.

3. Air intake shall be through the front bottom of the unit, and air exhaust shall be out the rear top of the unit.

4. Intake and exhaust shall have bird/rodent mesh guard and filtration.

5. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR TOLL EQUIPMENT

The UPS System shall come standard with software, RS232 interface via a DB-9F connector, and Ethernet interface via RJ-45 connector allowing full, interactive, remote computer monitoring and control of the UPS functions. The software shall allow the user to set up all operational parameters either locally or remotely and test the functionality of the unit. The unit shall be capable of sending simple network management protocol (SNMP) alarm traps upon alarm conditions and also be configurable via built in web page interface.

The UPS System Alarm Function Monitoring shall come standard with a DB-9F connector with open collectors (40 V @ 20 mA) indicating:

- Loss of Utility Power
- Inverter Failure
- Low Battery

The UPS System Front Panel Controls shall come standard with Power ON, Cold (DC) Start, Alarm Silence, Battery Test, Bypass Breaker and DC/Battery Breaker.

Reliability shall be calculated with mean time between failure (MTBF) as 100,000 hours based on component ratings.

CONSTRUCTION REQUIREMENTS

Contractor shall provide detailed design and installation plans for Engineer approval prior to installation. Power feeding the sign shall first terminate in the ground mounted cabinet. Non-UPS power shall pass through the cabinet to power non-UPS loads. Power required for sign backup shall feed through the UPS system. A bypass switch, rated for the designed system, shall be installed to bypass the UPS in the event of UPS failure or for system maintenance. A disconnect switch shall also be installed to disconnect UPS and line power from the sign. The Contractor shall install the DMS UPS output into the DMS power distribution panel per sign manufacture recommendations. Serial and Ethernet cables shall be installed from the UPS system ground cabinet to the sign communication device location. All wiring shall conform to the latest version of the NEC.

The UPS equipment shall include a minimum two year warranty on parts and labor. Batteries shall include a minimum two year pro rated warranty. Vendor shall be responsible for processing warranty repairs.

A repair option shall be available for UPS equipment no longer covered by the warranty period. Repair cost shall include all labor and materials necessary to complete the repair. Vendor shall be responsible for processing non- warranty repairs.

METHOD OF MEASUREMENT

The UPS will be measured by the actual number that are installed and accepted, and shall include all labor, materials, and equipment necessary to complete the work, including furnishing and installation of the model 332D cabinet and cabinet base, delivery to the installation site and standard warranty.

REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR VARIABLE TOLL MESSAGE SIGN (VTMS)

DESCRIPTION

This work consists of furnishing and installing a rack mounted Uninterruptible Power Supply (UPS), batteries, transfer switch, disconnect switch, and power connections in a Contractor supplied Model 332 cabinet, side mounted cooling fan and polycarbonate base at locations shown in the plans. The UPS system shall be capable of running essential sign control electronics, communication equipment, **and two** full LED sign faces allowing messaged display, and sign communications/control for at least 8 hours. The sign specification is entitled Variable Toll Message Sign (VTMS).

The UPS system shall be designed for a hot swap of components and shall not compromise existing operation of dynamic message signs or variable message signs. The unit shall provide for RS232 communication and contact closures for alarm functions.

MATERIALS

The UPS system shall provide "On-Line" dual conversion control. The UPS shall be rated per the following:

Input Voltage	85 VAC to 135 VAC line in neutral and 192VAC to 264VAC line to line
Input Frequency	48 to 62 Hz
Output Voltage	120 VAC +/- 3% 120/240 VAC, 1-Phase, 3 Wire plus Ground, +/- 3% Output Frequency 60 Hz
Power	VA required of running 2 VTMS signs at one location during a power outage for up to 8 hours. The unit shall be temperature rated to operate from 0 degree C to +40 degree C.

The UPS system shall be capable of producing simultaneously-fully regenerated, conditioned power with true sine wave and continuous AC outputs with stand by capability.

The unit shall have a re-settable power event counter to record the number of power utility failures, a battery run-time counter and temperature compensated battery charging.

The UPS System shall be capable of providing continuous, fully conditioned (both voltage and frequency), regulated, sinusoidal (AC) power to selected devices such as controllers, modems, and 5 volt power supplies, and sign face drivers.

Wiring shall comply with national electrical code (NEC) standards and approved wiring methods. Properly rated SO/SJO cords shall be allowed to allow easy replacement of the UPS System.

The interconnect cable shall be protected with abrasion-resistant nylon sheathing.

The UPS shall consist of two major components, the Electronics Module and the Battery System.

A. The Electronics Module shall consist of the following:

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR VARIABLE TOLL MESSAGE SIGN (VTMS)

1. True Sine wave, high frequency inverter.

2. Minimum 3-stage, temperature compensated, battery charger

9. For connection from the Electronics Module to the Battery System, a dedicated harness shall be provided with quick-release, keyed, circular connectors, and braided nylon sleeving over all conductors.

10. Local and remote control of UPS functions

11. Local and remote communications capabilities

B. The Battery System shall consist of the following:

1. Shall meet the continuous 8 hour requirement to run sign electronics, communication equipment, and half of the sign face with all LEDs illuminated at daytime brightness levels.

2. The batteries shall be comprised of extreme temperature, deep cycle AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid) batteries that have been field proven and tested by the U.S. military.

3. Batteries shall be certified to operate at extreme temperatures from -40’C to +74’C.

4. The batteries shall be provided with appropriate interconnect wiring and a corrosion-resistant mounting trays and/or brackets appropriate for the location into which they will be installed.

5. Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells and heavy-duty plates to withstand shock and vibration.

C. The UPS enclosure shall have forced air Cooling/Ventilation:

1. The UPS shall be forced air cooled by internally mounted, continuous fans.

2. Fan power shall be provided from the internal DC supply.

3. Air intake shall be through the front bottom of the unit, and air exhaust shall be out the rear top of the unit.

4. Intake and exhaust shall have bird/rodent mesh guard and filtration.

5. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded

The UPS System shall come standard with software, RS232 interface via a DB-9F connector, and Ethernet interface via RJ-45 connector allowing full, interactive, remote computer monitoring and control of the UPS functions. The software shall allow the user to set up all operational parameters either locally or remotely and test the functionality of the unit. The unit shall be capable of sending simple network

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR VARIABLE TOLL MESSAGE SIGN (VTMS)

management protocol (SNMP) alarm traps upon alarm conditions and also be configurable via built in web page interface.

The UPS System Alarm Function Monitoring shall come standard with a DB-9F connector with open collectors (40 V @ 20 mA) indicating:

- Loss of Utility Power
- Inverter Failure
- Low Battery

The UPS System Front Panel Controls shall come standard with Power ON, Cold (DC) Start, Alarm Silence, Battery Test, Bypass Breaker and DC/Battery Breaker.

Reliability shall be calculated with mean time between failure (MTBF) as 100,000 hours based on component ratings.

CONSTRUCTION REQUIREMENTS

Contractor shall provide detailed design and installation plans for Engineer approval prior to installation. Power feeding the sign shall first terminate in the ground mounted cabinet. Non-UPS power shall pass through the cabinet to power non-UPS loads. Power required for sign backup shall feed through the UPS system. A bypass switch, rated for the designed system, shall be installed to bypass the UPS in the event of UPS failure or for system maintenance. A disconnect switch shall also be installed to disconnect UPS and line power from the sign. The Contractor shall install the DMS UPS output into the DMS power distribution panel per sign manufacture recommendations. Serial and Ethernet cables shall be installed from the UPS system ground cabinet to the sign communication device location. All wiring shall conform to the latest version of the NEC.

The UPS equipment shall include a minimum two year warranty on parts and labor. Batteries shall include a minimum two year pro rated warranty. Vendor shall be responsible for processing warranty repairs.

A repair option shall be available for UPS equipment no longer covered by the warranty period. Repair cost shall include all labor and materials necessary to complete the repair. Vendor shall be responsible for processing non- warranty repairs.

METHOD OF MEASUREMENT

The UPS will be measured by the actual number that are installed and accepted, and shall include all labor, materials, and equipment necessary to complete the work, including furnishing and installation of the cabinet and cabinet base, delivery to the installation site and standard warranty.

REVISION OF SECTION 614
TRAVEL TIME INDICATOR

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work shall consist of furnishing and installing a Travel Time Indicator (TTI) in accordance with the Plans, these Special Provisions, and manufacturer's recommendations.

MATERIALS

For this project Travel Time Indicator shall include: a four channel multi-protocol IDentity 5204 Reader with power supply and communication cable, pole mountable 42 degree directional antennas per read direction, antenna signal cable and terminations, waterproofing mastic, Ethernet surge suppressor, serial surge suppressor, device configuration software, and any other related mounting hardware, cabling, and adaptors. At locations where the TTI is forward- looking over the managed lane, then there shall be a 22 degree antenna mounted per the plan details. The readers shall be housed at the communications cabinet.

Travel Time Indicator shall include:

1. IDentity 5204 reader with power supply. Shall be part number ID5204-001 as manufactured by 3M Company – MVSS, 3M Center, Bldg 235-3A-09, St. Paul, MN 55144-1000, Phone: 1-877-777-3571, Fax: 1-800-591-9293.

2. Communication Cable, 6 meter (20') length, RJ-45 terminated, Sirit Part Number S3114-021 or, alternatively Communication Cable, 2 meter (7') length, RJ-45 terminated, Sirit Part Number: S3114-20, whichever length is required.

3. Pole mountable 42 degree directional antenna shall be Sirit IDentity 5100 which includes a mount bracket.

   The forward-looking, overhead antenna for the managed lane shall be a Sirit Identity 5100 22 degree directional antenna.

   A. The antenna shall weigh 3 kg or less and have dimensions (17.7 x 17.7 x 1.4 in.). The antenna shall have a wind survival rating of 150 mph as defined in EIA-222-F and/or ETS 300 019-1-4.The antenna shall accommodate a male N-type coaxial connection. The antenna shall have a 902-928 MHz frequency range with 13.0 dBi gain and 50 ohm (nominal) input impedance. The antenna shall have a front to back ratio of -24db with a VSWR 1.7:1 or less.

4. Antenna signal cable and terminations.

   A. The antenna signal cable type is determined by the cable distance from the reader to the antenna. Signal loss at 900Mhz must be less than 4db per run. The following outdoor rated cable shall be used.

      (1) For runs 100 feet or less – LMR-400.

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REVISION OF SECTION 614
TRAVEL TIME INDICATOR

(2) For runs from 101-155 feet - LMR-600 iii. For runs from 156-230 feet – LMR 900

B. Signal cable shall be terminated with weatherproof male N-type crimp on straight plugs that have the following properties:

(1) Ferrule – Copper with Albaloy plating

(2) Contact pin – Brass with minimum 15µm gold plating

(3) Retaining ring – 304 stainless

(4) Gasket – Silicone v. Insulator – Teflon

(5) Shell/Body – Brass with Albaloy plating vii. Impedance – 50 Ω

(6) Insulation resistance – Greater than 5,000 MΩ

(7) Peak operating Voltage – 1,500 V

C. Sirit part number CONN-5200-K which includes 2 Male N-Type Connectors shall be used for LMR-400 antenna cable. One kit to facilitate one antenna.

5. Water-proofing mastic for antennas connections.

6. The Ethernet surge suppressor shall be DIN rail mountable and have RJ-45 connectors. It shall support transmission speeds up to 100 Mbps and 802.3at power over Ethernet (PoE) applications. The Ethernet surge suppressor shall comply with the following standards: GR 1089, NEC 800.100 and 830.100, ITU 703, UL94V-0 flame rated.

7. Serial surge suppressor shall be Wavetronix Click WX-CLK-200 or equivalent. (8) Device configuration software as provided by the manufacturer.

9. 0.75 inch Type 201 stainless steel strap with Type 201 stainless steel buckles.

10. Mounting hardware, cabling, and adaptors including but not limited to: 0.75 inch Type 201 stainless steel strap with Type 201 stainless steel buckles, Liquidtight flexible conduit with compatible connectors.

CONSTRUCTION REQUIREMENTS

The Travel Time Indicator reader shall be mounted inside the communications cabinet allowing room for all communication cable connections. A hook & 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.

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REVISION OF SECTION 614
TRAVEL TIME INDICATOR

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 directed by the Engineer per guidance from Matthew Becker at 303-435-8288. 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.

The Contractor shall install flexible conduit from the communication cabinet enclosure to the structure for signal cable and/or power cable installation as shown in the plans. 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 burs 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 shall not exceed 100 lf. (*** 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.

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 and/or wiring trays. All cable entrances in conduits, conduit entrances in structures and cabinets shall be sealed and waterproofed. Conduit/signal 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. 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.

CDOT ITS shall provide specific port numbers for managed lanes.

Antennas co-located on the same structure at the same location shall both be connected to a single reader. Contractor shall note that the plan quantities shown for TTI are for the readers and that locations as shown on the plans indicate the number of antennas associated with each reader.

RS-232 serial and Ethernet communications from the reader shall terminate on their respective surge suppression device. The connection to serial surge shall allow access to the reader via laptop computer.

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REVISION OF SECTION 614
TRAVEL TIME INDICATOR

The Contractor shall configure the Travel Time Indicator in accordance with manufacturer's recommendations and the following specifications:

The unit shall have CalTrans Title 21 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

Testing: A local field operations test shall be performed to demonstrate that all hardware, cables, and connections furnished and installed by the Contractor operate correctly and that all functions are in accordance with the requirements described herein. The power supply voltages and the functionality of the cabinet fans and heaters shall be verified. The contractor shall provide CDOT a 5-Day pretest notification and test completion notification. In addition, the Contractor shall prepare a Device Data Sheet (CDOT Form 1411) for each installed device and submit to CDOT.

Each TTI shall be tested for configuration, calibration, and read accuracy across each lane associated with the readers. For TTI detecting the general purpose lanes, associated travel lanes shall include all through lanes for the direction of travel. Managed Lanes TTI shall only have the tolling lane associated. Tests shall be conducted by the Contractor by driving a vehicle, or vehicles, with test tags (Title-21 and ISO-18000C) in each lane to provide verification. 10 sample reads shall be collected for each lane. The Contractor shall have a 5-day burn-in period prior to the testing.

A subsystem communication throughput test over the communication path between each field device and the communications hub shall be performed. The testing shall occur after all communication installation for a particular site has been completed, the communication paths between the device and the communications hub have been functional for at least 48 hours, and all fiber optic tests have been successfully passed. The Contractor shall notify CDOT at least 7 Days prior to beginning testing.

After successful completion of all subsystem test procedures and after all mainline lanes as well as ramps are open, each site shall be tested for proper functionality and device availability for 30 consecutive Days.

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REVISION OF SECTION 614
TRAVEL TIME INDICATOR

During the testing period, all equipment at the site that was provided, installed, or relocated by the Contractor shall operate without failures of any type. If any component malfunctions or fails to provide the capabilities specified herein during the 30- Day test period, within 48 hours of notification by CDOT, the Contractor shall troubleshoot to find the exact cause of the failure. The cost of correcting equipment malfunctions shall be the responsibility of the Contractor. After the component malfunction has been corrected to the satisfaction of CDOT, the 30-Day test period shall be restarted.

A CDOT staff member or an authorized CDOT representative shall witness and sign off on all tests.

REVISION OF SECTION 614
LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing, installing and testing full-color Light Emitting Diode (LED) lane use control signals and variable message signs, associated equipment controller and cabinets, cabinet foundation and mounting hardware at locations shown in the plans. The LED lane use control signal shall be a LED Dynamic Message Sign (LED DMS) equipped with 64x64 pixel matrix at 20mm pixel pitch and utilizing 24 bit RGB color. The LED variable message signs shall be LED DMSs equipped 80x80 pixel matrix at 20mm pixel pitch and utilizing 24 bit RGB color. One sign controller shall be capable of controlling and monitoring multiple lane use control signals. The signs and sign controllers shall be capable of operating without any decrease in performance over a temperature range of -34° F to +140° F and a relative humidity range of 0 to 99 percent, non-condensing.

MATERIALS

(a) *Certifications:* Prior to start of the installation of the LED DMS the Contractor shall provide the following certifications to the Engineer for review and approval:

12. Certification showing that the manufacturer of the LED DMS is fully compliant with ISO 9001 as of the bid date for this project. The ISO 9001 Certification shall apply to the facility, and to the design, fabrication, installation, and maintenance of the LED DMS. The facility where this company actually designs and manufactures the LED DMS shall be ISO 9001:2000 or later certified a minimum of one year prior to the bid date for this project.

13. Working drawings showing the sign housing and mounting brackets shall be sealed by a Professional Engineer registered in the State of Colorado and shall be submitted in accordance with subsection 105.02. The sign housing shall also be designed and PE sealed to comply with applicable requirements of current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

14. Certification showing that welding of the LED DMS housing is in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The LED DMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the ANSI/AWS D1.2-97 Structural Welding Code for Aluminum.

15. Certification that all aluminum face materials have a coating that meets or exceeds the requirements of the American Architectural Manufacturers Association (AAMA) Specifications Publication No. 2605. (16) Certification that the LEDs were tested and binned in accordance with the CIE Test Method A. Documentation and information on software as described in Appendix A of this document.

17. Documentation verifying the DMS is listed by an accredited 3rd party testing organization for conformance to UL48 and UL 1433.

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REVISION OF SECTION 614
LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

18. Documentation providing proof printed circuit board (PCB) conformal coating conformance to IPC-CC-830. (19) Documentation that the sign's structural integrity is in conformance to current American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals.

20. Documentation that the LED DMS conforms to the Transient Protection and Vibration of the NEMA Standard TS4, Section2.

(b) *Sign Housing:* All component parts shall be easily and readily accessible by a single person for inspection and maintenance. The housing shall be weather tight, and compliant to the National Electrical Manufacturers Association (NEMA) 3R Standard. All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The exterior front face surfaces shall be finish coated by a system that meets or exceeds the American Architectural Manufacturers Association (AAMA) Specification No. 2605. The finish shall be matte black.

The main body of the sign housing shall be constructed of aluminum with a natural mill finish. All exterior seams shall be continuously welded by an inert gas process, except for the coated fascia material.

The glazing shall be constructed of clear polycarbonate sheets with surfaces that resist hazing from UV light. The glazing shall be protected by an aluminum mask with apertures punched directly in front of each pixel. The coating shall meet or exceed the AAMA Specification No. 2605.

For surge protection, the system power shall be protected by two stages of transient voltage suppression devices. Tripping of each stage (or both if tripped simultaneously) of the surge protection shall cause the sign controller to report the error condition to central on the next poll (for multi-drop operation). There shall be an option that is either enabled or disabled and is selected and downloaded from the central system control software to the sign controller. When this option is enabled, tripping of the second stage of surge protection shall prevent power from reaching any components of the sign until the surge protection has been replaced. When this option is disabled, the sign will continue to function normally after the second stage of surge protection is tripped.

(c) *Sign Mounting Bracket Assembly:* The mounting brackets for lane use control signals shall be designed in accordance to standard sign mounting bracket for monotube structures.

(d) *Electronics:* All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods.

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LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

All PCBs shall be completely conformal coated in accordance to IPC CC-830 standard. The exception for this coating shall be the pixels on the front of the PCB of the LED motherboards and any components in sockets.

All integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and replacement. All circuit designs shall utilize high quality electronic components and shall provide a mean time before failure of at least 3 years. Provisions shall be made to prevent face fogging and condensation.

The sign shall be capable of operating with 120/240 VAC, 60 Hz, single phase power.

DMS pixels shall be constructed with discrete LEDs manufactured by a reputable manufacturer such as Avago Technologies (formerly Agilent Technologies), Nichia Corporation, OSRAM or EOI. Discrete LEDs shall conform to the following specifications:

- All LEDs shall have a nominal viewing cone of 30 degree angle of 15 degrees measured from the center of the longitudinal viewing cone.
- Color LEDs shall utilize AlInGaP semiconductor technology and shall emit light that has a peak wavelength of 590 □ 5 nm. Color LEDs shall utilize Red AlInGaP 626 nm, Green InGaN 525 nm and Blue InGaN 470 nm.
- The LED packages shall be fabricated from UV light resistant epoxy.
- The LED manufacturer shall perform intensity sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive luminous intensity “bins” as defined by the LED manufacturer.
- The LED manufacturer shall perform color sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive color “bins” as defined by the LED manufacturer.
- The various LED color and intensity bins shall be distributed evenly throughout the sign and shall be consistent from pixel to pixel. Random distribution of the LED bins shall not be accepted.
- The LED manufacturer shall assure color uniformity and consistency on the LED display face within the 30 degree cone of vision and shall not have inconsistent color and intensity shifts.
- LED package style shall be surface-mount or through-hole with or without standoffs.
- All LEDs used in all DMS provided for this contract shall be from the same manufacturer and of the same part number, except for the variations in the part number due to the intensity and color.

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LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

- The LEDs shall be rated by the LED manufacturer to have a minimum lifetime of 100,000 hours of continuous operation while maintaining a minimum of 70% of the original brightness.

Pixel power drawn from the DC supplies shall not exceed 1.5 watts per pixel, including the driving circuitry. The LED DMS shall be equipped with a minimum of three (3) photo sensors that measure outdoor ambient light level. These devices shall permit automatic light intensity measurement of light conditions at each sign location. These sensors shall be mounted in a manner to measure front, rear and ambient light conditions. Provisions shall be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

The power supplies shall be paralleled in a diode OR configuration such that one supply may completely fail and the sign will still be supplied with enough power to run 40% of all pixels.

The signs shall be capable of displaying ASCII characters 32 through 126 (including all upper and lower case letters and digits from 0 to 9) at any location in a message line.

(e) *Cabinet:* The cabinet shall be NEMA 3R ground mount traffic controller style cabinet with dual-sided access, polycarbonate base and cast-in-place concrete pad. The cabinet type shall be as follows:

DMS Equipment Cabinet (Type 1) shall be a Model 332 cabinet.

The equipment cabinet shall be natural aluminum with anchor bolts in accordance with the FHWA-IP-78-16 specification. The cabinet shall include the following minimum requirements:

- Two (2) internal (front/back) fluorescent lamps
- Full-height standard Electronics Industry Alliance (EIA) 19-inch rack with a minimum of one (1) pullout drawer
- Power panel board circuit breakers meeting the following minimum requirements
- Service entrance-rated
- Minimum of 12 circuit breaker mounting positions
- Short circuit rating of 22,000 amps for main and 10,000 amps branch circuits
- Underwriters' Laboratories (UL) Listed
- Two (2) 15-amp National Electrical Manufacturers Association (NEMA) 15-R 120VAC duplex outlet with one (1) ground-fault circuit interrupter.
- One (1) earth ground lug that is electrically bonded to the cabinet.
- One (1) thermostatically controlled 100 cubic feet per minute (cfm) exhaust fan mounted near the top of the cabinet.

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REVISION OF SECTION 614
LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

- Filtered air intake ports with removable and replaceable fan and filter located on the bottom third of each access door.
- Remote communication device.

A 19-inch rack mountable power conditioner shall be installed in the DMS Equipment Cabinet to provide – simultaneously- fully regenerated, conditioned power with true sine wave and continuous AC outputs to controllers, and communication devices.

The system power and communication lines shall each be protected by two stages of surge protection devices. The first stage shall be an arc discharge, gas discharge tube or a thyristor surge protection based unit with local and remote reporting capability. The second stage shall be metal oxide varistor (MOV) based. This second stage shall include a crowbar circuit, that when remotely enabled, shall trip the power circuit breaker when the second stage surge suppressor is activated. In both cases, tripping of each stage (or both if tripped simultaneously) of the surge protection and shall report the power surge condition to the sign controller for report to central. The crowbar shall be an option that is either enabled or disabled and is selected and downloaded from the central system control software to the sign controller. When this option is enabled, tripping of the second stage of surge protection shall prevent power from reaching any components of the sign until the surge protection has been replaced. When this option is disabled, the sign will continue to function normally after the second stage of surge protection is tripped.

(f) *Control and Communication:* The sign controller shall be supplied by the manufacturer of the LED DMS. The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with central control software in order to perform most DMS control functions.

The sign controller shall meet the following operational requirements:

- Communicate using embedded National Transportations Communication for
- Intelligent Transportation System Protocol (NTCIP) protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with graphical vacuum fluorescent display (VFD) or liquid crystal display (LCD) and keypad for direct operation and diagnostics
- Contain a minimum of one (1) NTCIP-compliant Ethernet port with RJ45 connector
- Have the ability to play volatile messages
- Contain LED DMS-specific control firmware (embedded software) that shall monitor all external and internal sensors and communication inputs and control the display modules as directed by external control software and the front panel interface

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LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

NTCIP shall be natively supported in the LED DMS controller. External protocol converter or translator devices shall not be allowed. The sign controller shall be programmed to receive and transmit NTCIP compliant sign control commands from the central system control software and laptop computer. The controller shall have power-up and auto-restart capabilities with programmable default actions when recovering from a power off condition. A hardware watch dog circuit shall provide automatic reset of the controller and communications device. Central control shall have ability to perform a remote command for the controller and communications device reset.

The controller shall be able to accept standard uninterruptible power supply (UPS) shutdown commands via Ethernet or serial interface.

The controller shall perform all communication, control and feedback functions and shall not require an intermediate control device and be the only sign controller. Communication and control lines between the sign controller and the system interface circuits shall be opto-coupled.

The sign controller shall be capable of being controlled from the central system control software via RS-232 serial and Ethernet communications.

The communications between the sign controller and the central system control software shall comply with the NTCIP. The sign controller shall support all NTCIP conformance levels, conformance groups, objects, and minimum storage sizes and ranges as specified in Appendix A.

In addition to the standard Management Information Base (MIB) objects, the sign shall include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined in this specification and in Appendix A.

Protect low voltage communication lines (twisted pair or coaxial) with multi-stage one- pair or two-pair surge suppressors designed for high-exposure applications, providing common mode and differential mode protection, with a maximum clamping voltage of 10 volts greater than peak DC or maximum AC RMS signal voltage and peak surge current rating of 10kA.

The sign controller shall be capable of being remotely reset from the central system control software.

The sign controller shall provide software modules that will allow integration with CDOT Colorado

Transportation Management System (CTMS) systems.

The sign controller shall allow user-configuration of maximum and minimum temperature in which to turn fans on and off.

The sign controller shall have polling capability and at a minimum shall be capable of reporting the status of the following:

1. Pixel operational status that includes every string of every pixel

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LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

2. Sign and ambient temperature

3. DC power supply status

4. The current state (on or off) of each pixel, including any pixel errors, in the actual, currently displayed message without disturbing the message in any way. This shall be real time and shall not be based on a previous pixel test.

5. Communication failure log

6. AC surge protector status

The controller software shall be capable of displaying the following types of messages:

1. Static or alternating messages capable of displaying any character or set of characters

2. Full Graphic capabilities.

The sign controller shall be capable of monitoring ambient light sensor circuits in the sign and convert the measured light intensity into the desired pixel brightness.

MANUFACTURER QUALIFICATIONS

The manufacturer shall supply experience documentation showing that the manufacturer has been in business, under the current corporate name, designing and manufacturing LED DMS for a minimum of 5 years prior to contract bid date; and that the manufacturer has in operation a minimum of 100 LED DMSs. These 100 LED

DMSs shall be from a minimum of 5 separate projects and operational for a minimum period of 3 years prior to the contract bid date.

WARRANTY

The Contractor shall ensure that the manufacturer can warranty the product for a minimum of 3 years for all parts returned to the factory, and full telephone technical support at no additional charge to CDOT. The technical support shall include access to a trained service representative who can respond within 24 hours to questions related to all LED DMS related equipment problems and maintenance issues.

TRAINING

The Manufacturer shall provide 8 hours of class room training for CDOT at the Colorado Transportation Management Center (CTMC) in Golden, Colorado. The Manufacturer shall supply 8 hours of on-site training in the sign for the CTMC staff.

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LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

CONSTRUCTION REQUIREMENTS

Contractor shall be fully responsible for the delivery of the signs, sign controllers, cabinets and cabinet bases to the installation site and any damages that occur in the installation delivery process. Construction of concrete pad and installation of controller cabinet base shall be done in accordance to CDOT standards.

Contractor shall provide a minimum of 10 feet of coiled slack power and control cables for each LED DMS in the pull boxes or inside the sign structure.

The LED DMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on site to ensure proper installation and testing.

The controllers for the lane use control signals and variable message signs shall be installed in accordance with manufacturer's recommendations inside the DMS equipment cabinets as shown on the Plans. A qualified factory representative shall be available on site to ensure proper installation and testing.

The Contractor shall submit an acceptance test procedure for approval and shall perform the test in the presence of CDOT and the manufacturer's representative. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Contractor shall notify CDOT at least two weeks prior to the test date.

Installation of all earth grounding shall conform to the current National Electric Code.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the LED DMS system, including spare software copies, shall be provided. Additional copies may be requested by the Engineer. One copy of the manual shall remain inside the sign housing or control cabinet. One copy shall be mailed to the Colorado Transportation Management Center at 425 C Corporate Circle, Golden, Colorado 80401.

Testing

A local field operations test shall be performed to demonstrate that all hardware, cables, and connections furnished and installed by the Contractor operate correctly and that all functions are in accordance with the requirements described herein. The power supply voltages and the functionality of the cabinet fans and heaters shall be verified. The contractor shall provide CDOT a 5-Day pretest notification and test completion notification. In addition, the Contractor shall prepare a Device Data Sheet for each installed device and submit to CDOT.

A subsystem communication throughput test over the communication path between each field device and the communications hub shall be performed. The testing shall occur after all communication installation for a particular site has been completed, the communication paths between the device and the communications hub have been functional for at least 48 hours, and all fiber optic tests have been successfully passed. The Contractor shall notify CDOT at least 7 Days prior to beginning testing.

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LANE USE CONTROL SIGNAL LED (SINGLE FACED) AND VARIABLE MESSAGE SIGN

After successful completion of all subsystem test procedures and after all mainline lanes as well as ramps are open, each site shall be tested for proper functionality and device availability for 30 consecutive Days. During the testing period, all equipment at the site that was provided, installed, or relocated by the Contractor shall operate without failures of any type. If any component malfunctions or fails to provide the capabilities specified herein during the 30- Day test period, within 48 hours of notification by CDOT, the Contractor shall troubleshoot to find the exact cause of the failure. The cost of correcting equipment malfunctions shall be the responsibility of the Contractor. After the component malfunction has been corrected to the satisfaction of CDOT, the 30-Day test period shall be restarted.

A CDOT staff member or an authorized CDOT representative shall witness and sign off on all tests.

METHOD OF MEASUREMENT

The lane use control signal and variable message sign will be measured by the actual number of signs that are installed, tested and accepted, and shall include all labor, materials, and equipment necessary to complete the work at each installation site, including delivery of all equipment and cabinets to the installation site; installation of sign controllers, auxiliary control panel, sign housing, and all associated electronics, communications equipment, DMS equipment cabinet (Type 1), and wiring; all tests as described herein; and standard warranty.

REVISION OF SECTION 614
VARIABLE TOLL MESSAGE SIGN (VTMS)

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

This work consists of furnishing and installing a Light Emitting Diode Variable Toll Message Sign (LED VTMS) and associated equipment cabinets at locations as shown in the plans. The sign shall be fully compatible with the mounting hardware and support structure shown on the plans. The LED VTMS shall be equipped with the ability to display 7 characters of text at a height of 18-inch tall characters. The pixel matrix shall be a minimum of 7x35. The sign shall include a power shut off mounted to the sign structure near the controller interface cabinet. The sign shall be capable of operating without any decrease in performance over a temperature range of -34° F to +140° F with a relative humidity of 0 to 99 percent, non-condensing. The sign shall have a minimum design life of 20 years.

MATERIALS

(a) *Certifications:* Prior to start of the installation of the LED VTMS the Contractor shall provide the following certifications to CDOT for Approval:

1. Certification showing that the manufacturer of the LED VTMS is fully compliant with ISO 9001 as of the bid date for this project. The ISO 9001 Certification shall apply to the facility, and to the design, fabrication, installation, and maintenance of the LED VTMS. The facility where this company actually designs and manufactures the LED VTMS shall be ISO 9001:2000 certified a minimum of one year prior to the bid date for this project.

2. Working drawings showing the sign housing shall be sealed by an Engineer registered in the State of Colorado and shall be submitted in accordance with subsection 105.02.

3. Certification showing that welding of the LED VTMS housing is in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The LED VMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the ANSI/AWS D1.2-97 Structural Welding Code for Aluminum.

4. Certification that all aluminum face materials have a coating that meets or exceeds the requirements of the American Architectural Manufacturers Association (AAMA) Specifications Publication No. 2605. (5) Certification that the LEDs were tested and binned in accordance with the CIE Test Method A.

6. Documentation and information on software as described in Appendix A of this document.

7. Documentation verifying the VTMS is listed by an accredited 3rd party testing organization for conformance to UL48 and UL 1433.

8. All workmanship shall comply with IPC-A-610C, Class 2 titled "Acceptability of Electronic Assemblies",

9. Documentation providing proof PCB silicon conformal coating conformance to MIL-I-46058C Type SR and IPC-CC-830.

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VARIABLE TOLL MESSAGE SIGN (VTMS)

10. Documentation that the sign's structural integrity is in Conformance to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals (Third Draft).

11. Documentation that the VMS conforms to the Transient Protection and Vibration of the NEMA Standard TS4, Section2.

(b) *Sign Housing:* All component parts shall be easily and readily accessible by a single person for inspection and maintenance. The housing shall be weather tight, and compliant to the NEMA 3R Standard.

All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The exterior front face surfaces shall be finish coated by a system that meets or exceeds the AAMA Specification No. 2605. The finish shall be matte black. The main body of the sign housing shall be constructed of aluminum with a natural mill finish. All exterior seams shall be continuously welded by an inert ga process, except for the coated fascia material.

The glazing shall be constructed of clear polycarbonate sheets with surfaces that resist hazing from UV light. The glazing shall be protected by a coated 0.090 inch aluminum mask with apertures punched directly in front of each pixel. The coating shall meet or exceed the AAMA Specification No. 2605.

For surge protection, the system power shall be protected by two stages of transient voltage suppression devices. Tripping of each stage (or both if tripped simultaneously) of the surge protection shall cause the sign controller to call central and report the error condition (for dialup operation) or report the error condition to central on the next poll (for multi-drop operation). There shall be an option that is either enabled or disabled and is selected and downloaded from the central system control software to the sign controller. When this option is enabled, tripping of the second stage of surge protection shall prevent power from reaching any components of the sign until the surge protection has been replaced. When this option is disabled, the sign will continue to function normally after the second stage of surge protection is tripped.

(c) *Sign controller:* The sign controller shall be installed into the VTMS cabinet on the side of the road at the locations shown in the plans. Each VTMS shall be controlled and monitored by its own sign controller. The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with VTMS control software in order to perform most VTMS control functions.

The sign controller shall meet the following operational requirements:

- Communicate using embedded NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with graphical VFD or LCD and keypad for direct operation and diagnostics as described herein

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VARIABLE TOLL MESSAGE SIGN (VTMS)

- Contain a minimum of two (2) NTCIP-compliant RS232 communication ports
- Contain a minimum of one (1) NTCIP-compliant Ethernet port with RJ45 connector
- Have the ability to play volatile messages
- Contain VMS-specific control firmware (embedded software) that shall monitor all external and internal sensors and communication inputs and control the display modules as directed by external control software and the front panel interface
- Ability for remote firmware upgrades that error check to eliminate firmware corruption

NTCIP shall be natively supported in the VTMS controller. External protocol converter or translator devices shall not be allowed. The sign controller shall be programmed to receive and transmit NTCIP compliant sign control commands from the central system control software and laptop computer. The controller shall have power-up and auto-restart capabilities with programmable default actions when recovering from a power off condition. A hardware watch dog circuit shall provide automatic reset of the controller and communications device. Central control shall have ability to perform a remote command for the controller and communications device reset. The controller shall be able to accept standard UPS shutdown commands via Ethernet or serial interface

The Controller shall perform all communication, control and feedback functions and shall not require an intermediate control device and be the only sign controller. Communication and control lines between the sign controller and the system interface circuits shall be opto-coupled.

(d) *Electronics:* All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods.

All Printed Circuit Boards (PCBs) shall be completely conformal coated with a silicone resin that meets the IPC CC-830 standard. The exception for this coating shall be the pixels on the front of the PCB of the LED motherboards and any components in sockets.

All integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and replacement. All circuit designs shall utilize high quality electronic components and shall provide a meantime before failure of at least 3 years.

The sign and the controller shall be capable of operating with 120/240 VAC, 20 amp per leg, 60 Hz, single phase power. Each circuit in the sign shall be powered from a circuit breaker. Inside the roadside cabinet, all 120 VAC service lines shall be independently protected by a thermo-magnetic circuit breaker at the sign housing entry point. All 120 VAC wiring shall be located in conduit, pull boxes, raceways, or control cabinets as required by the National Electrical Code (NEC). No 120 VAC wiring shall be exposed within or outside of the sign housing.

The pixels shall be red/green/amber in color and utilize precision optical performance AlInGaP II LEDs (for red LEDs) or InGaN LEDs (for green LEDs) constructed of aluminum indium gallium phosphide. The brightness and color of each pixel shall be uniform over the entire face of the sign within the 30-degree cone of vision from minimum of 200 feet up to and including 1,100 feet in all lighting conditions. Each pixel shall be 40 candelas at

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VARIABLE TOLL MESSAGE SIGN (VTMS)

20mA as measured by the sum of the brightness of the individual LEDs in each pixel. The brightness of each LED shall be measured in accordance with CIE Test Method A, as described in CIE 127-1997, Technical Report: Measurement of LEDs.

Each pixel shall contain two strings of LEDs. The pixel strings shall be powered from a regulated DC power source and the LED current shall be maintained at 25 plus or minus three milliamperes per string to maximize life of the pixel. The failure of an LED in one string within a pixel shall not affect the operation of any other string or pixel. The LEDs shall be capable of operating in a temperature range of –40 degrees to +100 degrees C. The LEDs shall be moisture resistant epoxy with UV-A and UV-B inhibitors.

Pixel power drawn from the DC supplies shall not exceed 1.5 watts per pixel, including the driving circuitry.

A minimum of one photocell shall be installed on the sign. This device shall permit monitoring of light conditions at each sign location and automatic selection of light intensity levels. The method or algorithm used to calculate the intensity level shall be determined by the manufacturer and tested under real-world lighting conditions.

The power supplies shall be paralleled in a diode OR configuration such that one supply may completely fail and the sign will still be supplied with enough power to run 40% of all pixels. The power supply shall be located inside the roadside cabinet and not in the sign. The Contractor shall work with the Vendor to determine proper cabling requirements from the cabinet to the sign.

All cables shall be securely clamped/tied in the sign housing. No adhesive attachments will be allowed.

The signs shall be capable of displaying ASCII characters 32 through 126 (including all upper and lower case letters and digits from 0 to 9) at any location in a message line.

The Contractor shall be responsible for locating the nearest electrical power and telephone sources and connecting those sources to the appropriate terminations with the LED VTMS. The Contractor shall cooperate with the local electrical and telephone utilities to establish a service accounts at the direction of the Engineer.

(e) *Communication:* The sign controller shall be capable of being controlled from the central system control software and the controller interface cabinet via RS-232 serial and Ethernet communications.

The sign controller shall include separate interfaces for communication with the central system control software and the controller interface cabinet.

The communications between the sign controller and the central system control software and controller interface cabinet shall comply with the NEMA National Transportation Communications for ITS Protocol (NTCIP). The sign controller shall support all NTCIP conformance levels, conformance groups, objects, and minimum storage sizes and ranges as specified in APPENDIX A.

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In addition to the standard Management Information Base (MIB) objects, the sign shall include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined in this specification and in APPENDIX A.

Dial-up or hardwire multi-drop communication lines shall be protected by two stages of transient voltage suppression devices including MOVS and spark gap arrestor.

The sign controller shall be capable of being remotely reset from the central system control software.

The sign controller shall allow user-configuration of maximum and minimum temperature in which to turn fans on and off.

The sign shall have polling capability and at a minimum shall be capable of reporting the status of the following:

1. Pixel operational status that includes every string of every pixel

2. Sign and ambient temperature

3. DC power supply status

4. The current state (on or off) of each pixel, including any pixel errors, in the actual, currently displayed message without disturbing the message in any way. This shall be real time and shall not be based on a previous pixel test.

5. Communication failure log

6. UPS status

7. AC surge protector status

The controller software shall be capable of displaying static messages, including any character or set of characters

It shall be possible to flash any character or set of characters in an alternating message at the adjustable frequencies listed above for flashing messages. The flashing period shall be a sub-multiple of the associated alternating on time. It shall also be possible to flash any character or set of characters in a static message.

The sign controller shall monitor the photo cell circuits in the sign and convert the measured light intensity into the desired pixel brightness.

MANUFACTURER QUALIFICATIONS

The manufacturer shall supply experience documentation showing that the manufacturer has been in business, under the current corporate name, designing and manufacturing freeway LED Variable Message

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VARIABLE TOLL MESSAGE SIGN (VTMS)

Signs of a similar type for a minimum of 5 years; and that the manufacturer has in operation a minimum of 100 LED VMS. These 100 VMS shall be from 5 separate projects and operational for a minimum of 5 years.

CONSTRUCTION REQUIREMENTS

Contractor shall be fully responsible for the delivery of the sign to the installation site and any damages that occur in the installation delivery process.

The LED VTMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on site to ensure proper installation and testing.

The Contractor shall submit a "VTMS acceptance test procedure" for acceptance and shall perform the test in the presence of CDOT and the manufacturer's representative. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Contractor shall notify CDOT at least two weeks prior to the test date.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the VTMS system, including software copies, shall be provided. Additional copies may be requested by CDOT. One copy of the manual shall remain inside the sign controller cabinet on the side of the road. One copy shall be delivered to the CDOT construction project engineer.

WARRANTY

(a) *Standard Warranty.* The contractor shall ensure that the manufacturer can warranty the product for a minimum of 3 years for all parts returned to the factory, and full telephone technical support at no additional charge to the Department. The technical support shall include access to a trained service representative who can respond within 24 hours to questions related to all VTMS related equipment problems and maintenance issues.

METHOD OF MEASUREMENT

The LED VTMS will be measured by the actual number that are installed and accepted, and shall include all labor, materials, and equipment necessary to complete the work, including the sign controller, controller interface box, sign housing, electronics, communications equipment, delivery to the installation site and standard warranty.

Appendix A

NTCIP Requirements

This portion of the specification defines the detailed NTCIP requirements for the Variable Message Signs covered by the project specifications.

This specification references several standards through their NTCIP designated names. The following list provides the full reference to the current version of each of these standards. In many cases, the standard is

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more widely known by its original NEMA assigned number, in these cases, the NEMA number is also identified. The content of the NEMA standard is identical to that of the NTCIP standard.

Each NTCIP Component covered by these project specifications shall implement the most recent version of the standard that is at the stage of Recommended or higher as of Sunday, April 03, 2001, including any and all Approved or Recommended Amendments to these standards as of the same date. It is the ultimate responsibility of the vendor to monitor NTCIP activities to discover any more recent documents.

General Requirements: Transport Level

Each NTCIP Component shall comply with NTCIP 2202, (NEMA TS 3.Internet). NTCIP Components may support additional Transport Profiles at the manufacturer's option. Response datagrams shall use the same Transport Profile used in the request. Each NTCIP Component shall support the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

Application Level

Each VMS shall comply with NTCIP 2301, (NEMA TS 3.AP-STMF), as a Managed Agent and shall meet the requirements for Conformance Level 1 (NOTE – See Amendment to standard). SNMP shall be required and STMP shall not be required. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Responses shall use the same Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

Information Level

Each NTCIP Component shall provide Full, Standardized Object Range Support of all objects required by these procurement specifications, unless otherwise indicated below. The maximum Response Time for any object or group of objects shall be 200 milliseconds.

The vendor's software shall implement all mandatory objects of the mandatory conformance group defined in NTCIP 1201, (NEMA TS 3.4) Global Object Definitions:

- Configuration Conformance Group – Section 3.1
- Security Conformance Group (new in Amendment 1)

The vendor's software shall implement the mandatory objects of the optional conformance groups defined in NTCIP 1201, (NEMA TS 3.4), Global Object Definitions:

- Time Management Conformance Group – Section 3.3
- TimeBase Event Schedule Conformance Group – Section 3.4
- Report Conformance Group – Section 3.5

The vendor's software shall implement all mandatory objects of all mandatory conformance groups defined in NTCIP 1203, (NEMA TS 3.6) Object Definitions for Variable Message Signs:

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- Sign Configuration Conformance Group – Section 4.1
- Message Table Conformance Group – Section 4.6
- Sign Control Conformance Group – Section 4.7

The vendor's software shall implement all mandatory objects of the optional conformance groups defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

- GUI Appearance – Section 4.2
- Font Definition – Section 4.3
- VMS Sign Configuration – Section 4.4
- MULTI Configuration – Section 4.5
- Default Message – Section 4.8
- MULTI Error – Section 4.10
- Illumination/Brightness – Section 4.11
- Scheduling – Section 4.12
- Auxiliary I/O – Section 4.13
- Sign Status – Section 4.14
- Status Error – Section 4.15
- Pixel Error Status – Section 4.16
- Fan Error Status – Section 4.18
- Temperature Status – Section 4.17

The vendor's software shall implement the following optional objects defined in NTCIP 1203, (NEMA TS 3.6):

- dmsMessageBeacon – Section 2.6.1.1.1.8.6
- dmsSWReset – Section 2.7.1.1.1.1
- dmsMessageTimeRemaining – Section 2.7.1.1.1.4
- dmsShortPowerRecoveryMessage – Section 2.7.1.1.1.8
- dmsLongPowerRecoveryMessage – Section 2.7.1.1.1.9
- dmsShortPowerLossTime – Section 2.7.1.1.1.10
- dmsResetMessage – Section 2.7.1.1.1.11
- dmsCommunicationsLossMessage – Section 2.7.1.1.1.12
- dmsTimeCommLoss – Section 2.7.1.1.1.13

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- dmsPowerLossMessage – Section 2.7.1.1.1.14
- dmsEndDurationMessage – Section 2.7.1.1.1.15
- dmsMultiOtherErrorDescription – Section 2.7.1.1.1.20
- dmsStatDoorOpen – Section 2.11.1.1.1.6
- fanFailures – Section 2.11.2.1.1.8
- fanTestActivation – Section 2.11.2.1.1.9
- tempMinCtrlCabinet – Section 2.11.4.1.1.1
- tempMaxCtrlCabinet – Section 2.11.4.1.1.2
- tempMinAmbient – Section 2.11.4.1.1.3
- tempMaxAmbient – Section 2.11.4.1.1.4
- tempMinSignHousing – Section 2.11.4.1.1.5
- tempMaxSignHousing – Section 2.11.4.1.1.6

The vendor's software shall implement the following tags (opening and closing where defined) of MULTI as defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

MULTI Tag

1 Field

2 Flash

3 Font

4 Hexadecimal Character

5 Justification Line

6 Justification Page

7 Moving Text

8 New Line

9 New Page

10 Page Time

11 Spacing – Character

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The Field Tag shall support the following field ID's:

Field Tag ID	Description
1	Time, 12-hour format (no AM/PM indicator)
2	Time, 24-hour format
3	Temperature in degrees Celsius
4	Temperature in degrees Fahrenheit
5	Day of week
6	Day of month
7	Month of year
8	Year, 2-digits
9	Year, 4-digits

Sizes and Ranges

All objects required by these procurement specifications shall support all values within its standardized range. The standardized range is defined by a size, range, or enumerated listing indicated in the object's SYNTAX field and/or through descriptive text in the object's DESCRIPTION field of the relevant standard. The following provides the current listing of known variances for this project:

Object Reference		Minimum Project Requirements
NTCIP 1201 (TS 3.4)		
moduleTableEntry	2.2.3	Shall contain at least one row with moduleType equal to 3 (software). The moduleMake shall specify the name of the manufacturer, the moduleModel shall specify the manufacturer's name of the component and the modelVersion shall indicate the model version number of the component.
maxTimeBaseScheduleEntries	2.4.3.1	7
maxDayPlans	2.4.4.1	7
maxDayPlanEvents	2.4.4.2	7
maxEventLogConfigs	2.5.1	50
eventConfigMode	2.5.2.3	2,3,and 4
maxEventLogSize	2.5.3	200
maxEventClasses	2.5.5	7
maxGroupAddress	2.7.1	1

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NTCIP 1203 (TS 3.6)

dmsNumPermanentMsg	2.6.1.1.1.1	50
dmsMaxChangeableMsg	2.6.1.1.1.3	50
dmsFreeChangeableMemory	2.6.1.1.1.4	50KB
dmsMaxVolatileMsg	2.6.1.1.1.6	50
dmsFreeVolatileMemory	2.6.1.1.1.7	50KB
dmsMsgMultiString	2.6.1.1.1.8.3	See attached table
dmsControlMode	2.7.1.1.1.1	2,4,5
numFonts	2.4.1.1.1.1	4
maxFontCharacters	2.4.1.1.1.3	127
vmsCharacterHeightPixels	2.3.1.1.1.1	5
vmsCharacterWidthPixels	2.3.1.1.1.2	7
vmsSignHeightPixels	2.3.1.1.1.3	3
vmsSignWidthPixels	2.3.1.1.1.4	10
vmsHorizontalPitch	2.3.1.1.1.5	70mm
vmsVerticalPitch	2.3.1.1.1.6	70mm
defaultBackgroundColor	2.5.1.1.1.1	0 (black)
defaultForegroundColor	2.5.1.1.1.2	9 (amber)
defaultJustificationLine	2.5.1.1.1.6	2,3,4
defaultJustificationPage	2.5.1.1.1.7	2,3,4
defaultFlashOn	2.5.1.1.1.3	0.5 to 5.0
defaultFlashOff	2.5.1.1.1.4	0.5 to 5.0
defaultPageOnTime	2.5.1.1.1.8	0.5 to 5.0
defaultPageOffTime	2.5.1.1.1.9	0.5 to 5.0
defaultCharacterSet	2.5.1.1.1.10	eightBit (2)
numActionTableEntries	2.9.1.1.1.1	15

Documentation

Software shall be supplied with full, electronic documentation containing ASCII versions of the following

Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.
- If the device does not support the full range of any given object within a Standard MIB Module, a vendor specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro. The filename of this file shall be identical to the standard MIB Module, except that it will have the extension ".man".
- A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

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VARIABLE TOLL MESSAGE SIGN (VTMS)

The vendor shall allow the use of any and all of this documentation by any party authorized by CDOT for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

REVISION OF SECTION 614
TOLL SYSTEM INTEGRATION

Section 614 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Subsection 614.01 shall include the following:

This work includes furnishing and installing infrastructure to support an electronic toll collection system to be provided by the Systems Integrator under separate contract to CDOT / High Performance Tolling Enterprise (HTPE). Infrastructure is to be furnished and installed by the Contractor which includes: PVC conduit, electrical power, gantries, poles, foundations and cabinets as shown in the plan sheets and described in the Special Provisions. Supporting / coordinating activities include lane closures and traffic control as requested by the Systems Integrator and approved according to applicable lane closure policies and traffic control plan general.

MATERIALS

Subsection 614.02 shall include the following:

All infrastructure components, lane closures, and traffic control shall comply with the individual specifications related to them within these Special Provisions.

CONSTRUCTION REQUIREMENTS

Subsection 614.09 shall include the following:

The System Integrator will be required to follow the applicable lane closure policy for traffic control for all equipment installation, configuration, integration, and testing activities on the facility. In addition, the System Integrator will be required to schedule all work activities with the contractor and provide at least 48 hours' notice of any lane closures needed to do the work. If a lane closure cannot be accommodated the contractor shall propose another time period that is conducive to their work schedule. Any delays to the project due to scheduling this work are the responsibility of the contractor.

The Contractor will provide and coordinate traffic control for the System Integrator's activities during the requested and approved lane closure.

Due to long delays regarding equipment of this nature the contractor can expect up to 6 months backlog from vendors to receive equipment for this work both by the Toll system integrator and the contractor and this should be taken into account in the work schedule. This will include conduit, cabinets, wire, toll equipment, poles, attachments, AVI readers, backup systems, mounting brackets, fiber connectors, connection, etc.

REVISION OF SECTION 614
MAINTENANCE OF ITS

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This specification describes the requirements for maintaining communications and functionality for all existing and proposed ITS devices and infrastructure during construction. ITS devices and infrastructure shall include all electronic devices and associated equipment, and all communications infrastructure.

CONSTRUCTION REQUIREMENTS

Maintenance during construction:

The Contractor shall maintain all ITS devices and communications throughout construction.

Resetting and reconfiguring devices or communications or performing cutovers, as required, shall not exceed 48 hours of downtime. All proposed equipment, power, and any temporary communications necessary for maintaining ITS during construction shall be constructed and put in place prior to the cutover or reset in order to minimize downtime of devices.

The Contractor shall submit a cutover plan to CDOT ITS for review prior to performing the work. This cutover plan shall detail how the Contractor will sequence the construction activities so that the existing devices such that the 48-hour downtime is not exceeded.

If temporary wireless communications are needed because fiber optic connectivity cannot practically be maintained during construction for a long duration then Pay Item – Telemetry (Master) shall be used to provide cellular CDMA communications from the field device to the CTMC, as appropriate. However, any new devices shall be procured, furnished, and installed prior to such service disruption to meet the downtime requirement. No more than 2 ITS devices may be on temporary wireless communications at one time.

REVISION OF SECTION 614
CONTROLLER CABINET FOUNDATION

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing a fiberglass porch-style traffic signal controller base in the field for 334 traffic signal controller cabinet foundations at ramp meter and automatic traffic recorder locations.

MATERIALS

Section 614.10 (e) shall include the following:

Controller foundations shall be preformed type and shall meet the following requirements: Controller foundation shall be manufactured of fiberglass reinforced polymer concrete.

Foundation dimensions shall conform to the detail in the plans. A minimum of 4 - ½ inch x 13 Unified Coarse Thread (UNC) inserts shall be installed for mounting of the controller cabinet to the foundation. Placement of the mounting inserts shall match the mounting configuration of the controller cabinet. The foundation shall be provided with an opening to accommodate access of underground conduit into the controller cabinet. Foundation opening shall match the controller cabinet opening as closely as possible. A minimum of 4 – ½ inch x 13 UNC lifting inserts shall be installed at each corner of the controller cabinet foundation. Lifting inserts shall be designed to support the full weight of the foundation to aid in the moving and placing of the foundation. The walking surface of the foundation shall have a skid resistant surface encompassing three sides of the controller cabinet so field personnel can walk on the foundation from the front door to the back cabinet door.

REVISION OF SECTION 614
COMMUNICATIONS CABINET

Section 614 of the Standard specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing communications cabinets at designated tolling zone locations to house and protect electrical power components as shown on the Plans. Communication Cabinet shall be a Type M Stretch Cabinet furnished and installed at designated Tolling field device sites to house and protect electrical power components, field equipment, serial servers, communications telemetry equipment and fiber optic termination panels. Each Communication Cabinet shall be ground-mounted, including a concrete pad and base.

MATERIALS

Communication Cabinets. The nominal dimensions shall be as shown in Table 1 below. Some variance from these dimensions may be accepted at the Engineer's discretion.

Table 1 - Communications Cabinet Types

Cabinet Type	Dimensions
Communications Cabinet (Type M Stretch)	68" (H) × 31" (W) × 19" (D)

Communications cabinets shall be UL 508A *Industrial Control Panels* listed and conform to a NEMA Type 3R rating. Communications cabinets shall be H-32 aluminum conforming to the requirements of ASTM B209 *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate*.

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.

A cabinet grounding stud shall be provided in the vicinity of the ground bus mounted on the back panel as shown on the Plans.

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 openings shall be designed to prevent dust and moisture intrusion in conformance to NEMA 3R requirements. All flange joints shall be welded or continuously formed. The doors shall have an adequately sized, oil- resistant gasket that provides a uniform seal with the door frame surface in conformance with NEMA 3R 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 and Corbin #2 key lock be utilized in place of the hasp and staple if

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REVISION OF SECTION 614
COMMUNICATIONS CABINET

the NEMA 3R rating can be maintained. 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.

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.

Back Panels

A back panel shall be constructed of 0.10 inch Type 5052-H32 aluminum alloy, unless otherwise specified by the

Department. Two back panels and associated mounting hardware shall be included with each communications cabinet and be rated for use in NEMA 3R cabinets. The back panel shall be approximately 1-inch less than the inside dimensions. The back panel shall be 1-inch thick, with air space to allow for mounting screws to be used from either side without protrusion through the opposing face. The back panel shall be mounted within the communications cabinet with a minimum of four screws on an adjustable sliding channel.

Outlet Box

A minimum of 10 NEMA 5-20R receptacles shall be provided per toll point within outlet boxes opposing the external service disconnect. At the combined tolling point, 20 NEMA 5-20R receptacles shall be provided. NEMA 5-20R receptacles shall be rated for 125 VAC, 0.5 HP and 20 A. It shall be of commercial grade quality and be manufactured from high strength nylon. NEMA 5-20 receptacles shall have two poles, three wires and include a self-grounding strap to insure ground contact. Receptacles shall be UL listed.

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) × 2.25 inches (w)

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REVISION OF SECTION 614
COMMUNICATIONS CABINET

× 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.

Service Disconnect. Each service disconnect shall be readily accessible and installed on the exterior of the cabinet close to the door so that the center of the grip of the operating handle of the circuit breaker, when in its highest position, is not more than 6 feet 7 inches above the ground or as required per Article 240.24 of the NEC. The neutral from the power source or service enclosure shall be connected to the ground bar in the service disconnect. The ground bar shall be connected to the service disconnect using a bonding strap.

The ground bar shall be connected to a grounding electrode using grounding conductors conforming to the requirements of Article 250.122 of the NEC. The grounding electrode shall conform to the requirements of Articles 250.52 through 250.70 of the NEC. The service disconnect shall feed a duplex NEMA 5-15R mounted on the inside of the cabinet.

Foundation. Each Communication Cabinet shall include a polymer concrete or poured concrete pad that extends at least 2'-6" beyond the cabinet base on each cabinet door side and at least 6" beyond the cabinet base on the other two sides. The cabinet base shall be sealed around the conduits.

CONSTRUCTION REQUIREMENTS

Each communications cabinet shall have tapped pads to provide for the mounting of a back panel as specified herein. Conduit accesses into the cabinet for electrical wiring, specific field device low-voltage control cabling, waveguides and fiber optic cabling, shall be plugged with a manual plug (no foam sealant is allowed). After installation, the top of the cabinet should be approximately 5 feet above the prevailing ground line

REVISION OF SECTION 614
COMMUNICATIONS CABINET (TYPE I)

Section 614 of the Standard specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing communications cabinets at designated Intelligent Transportation System (ITS) field device locations to house and protect electrical power components as shown on the Plans. Communication Cabinet (Type 1) shall be furnished and installed at designated Intelligent Transportation System (ITS) field device sites to house and protect electrical power components, DIN rails, field equipment, serial servers, communications telemetry equipment and fiber optic termination panels. Each Communication Cabinet (Type 1) shall be pole-mounted.

MATERIALS

Communication Cabinets. The nominal dimensions shall be as shown in Table 1 below. Some variance from these dimensions will be accepted, at the Engineer's discretion.

Table 1 - Communications Cabinet Types

Cabinet Type	Dimensions	Maximum Weight (w/o back panel)
Communications Cabinet (Type 1)	30" (H) × 24" (W) × 12" (D)	N / A

Communications cabinets shall be UL 508A *Industrial Control Panels* listed and conform to a NEMA Type 3R rating. Communications cabinets shall be H-32 aluminum conforming to the requirements of ASTM B209 *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate*.

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.

A cabinet grounding stud shall be provided in the vicinity of the ground bus mounted on the back panel as shown on the Plans.

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 openings shall be designed to prevent dust and moisture intrusion in conformance to NEMA 3R requirements. All flange joints shall be welded or continuously formed. The doors shall have an adequately sized, oil- resistant gasket that provides a uniform seal with the door frame surface in conformance with NEMA 3R 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.

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REVISION OF SECTION 614
COMMUNICATIONS CABINET (TYPE I)

Hinges shall be mounted with appropriately sized stainless steel hardware. The door shall be equipped with a hasp and staple for padlocking and Corbin #2 key lock be utilized in place of the hasp and staple if the NEMA 3R rating can be maintained. 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.

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.

Back Panels

Back panels shall be constructed of 0.10 inch Type 5052-H32 aluminum alloy, unless otherwise specified by the

Department. Two back panels and associated mounting hardware shall be included with each communications cabinet and be rated for use in NEMA 3R cabinets. The back panel shall be approximately 1-inch less than the inside dimensions. The back panel shall be 1-inch thich, with air space to allow for mounting screws to be used from either side without protrusion through the opposing face. The back panel shall be mounted within the communications cabinet with a minimum of four screws on an adjustable sliding channel.

Outlet Box

The communications cabinet shall contain a 4 inch square junction box attached to the back panel and near the door opposing the external service disconnect on side B. 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.

A duplex NEMA 5-15R receptacle shall be provided within the outlet box opposing the external service disconnect. 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 mounted to the backplane of side A. 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.

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 (TYPE I)

Power Conditioner

The power conditioner shall be a Clary SP400U Universal 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 (± 3%), user selectable 50 to 60 Hz (± 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) × 11 inches (w) × 8.5 inches depth and its weight shall not exceed 5 lbs. One power conditioner shall be provided with each communications cabinet.

An integral component of the power conditioner shall be a factory-installed power strip. The power strip shall have six front facing NEMA Type 5-15R outlets. 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. The dimensions of the power strip shall be 10 inches (L) × 1.63 inches (W).

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 × 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) × 2.25 inches (w) × 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.

Service Disconnect. Each service disconnect shall be readily accessible and installed on the exterior of the cabinet close to the door so that the center of the grip of the operating handle of the circuit breaker, when in its highest position, is not more than 6 feet 7 inches above the ground or as required per Article

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REVISION OF SECTION 614
COMMUNICATIONS CABINET (TYPE I)

240.24 of the NEC. The neutral from the power source or service enclosure shall be connected to the ground bar in the service disconnect. The ground bar shall be connected to the service disconnect using a bonding strap.

The ground bar shall be connected to a grounding electrode using grounding conductors conforming to the requirements of Article 250.122 of the NEC. The grounding electrode shall conform to the requirements of Articles 250.52 through 250.70 of the NEC. The service disconnect shall feed a duplex NEMA 5-15R mounted on the inside of the cabinet.

Pole Mounting Kit

Each communications cabinet, designated for mounting on a pole, shall include a pole mounting kit suitable the pole diameters for which the cabinet will be mounted. 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 3R 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. Conduit accesses into the cabinet for electrical wiring, specific field device low-voltage control cabling, waveguides and fiber optic cabling, shall be plugged with a manual plug (no foam sealant is allowed). After installation, the top of the cabinet should be approximately 5 feet above the prevailing ground line.

REVISION OF SECTION 614
COMMUNICATIONS CABINET (TYPE 2)

Section 614 of the Standard specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing communications cabinets at designated Intelligent Transportation System (ITS) field device locations to house and protect electrical power components as shown on the Plans. Communication Cabinet (Type 2) shall be a Caltrans 336S furnished and installed at designated Intelligent Transportation System (ITS) field device sites to house and protect electrical power components, DIN rails, field equipment, serial servers, communications telemetry equipment and fiber optic termination panels. Each Communication Cabinet (Type 2) shall be ground-mounted, including a raised polymer concrete or poured concrete pad and base.

MATERIALS

Communication Cabinets. The nominal dimensions shall be as shown in Table 1 below. Some variance from these dimensions will be accepted, at the Engineer's discretion.

Table 1 - Communications Cabinet Types

Cabinet Type	Dimensions	Maximum Weight (w/o back panel)
Communications Cabinet (Type	36 inches (H) × 24 inches (W) × 24 inches	N / A

Communications cabinets shall be UL 508A *Industrial Control Panels* listed and conform to a NEMA Type 3R rating. Communications cabinets shall be H-32 aluminum conforming to the requirements of ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

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.

A cabinet grounding stud shall be provided in the vicinity of the ground bus mounted on the back panel as shown on the Plans.

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 openings shall be designed to prevent dust and moisture intrusion in conformance to NEMA 3R requirements. All flange joints shall be welded or continuously formed. The doors shall have an adequately sized, oil- resistant gasket that provides a uniform seal with the door frame surface in conformance with NEMA 3R 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.

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REVISION OF SECTION 614
COMMUNICATIONS CABINET (TYPE 2)

Hinges shall be mounted with appropriately sized stainless steel hardware. The door shall be equipped with a hasp and staple for padlocking and Corbin #2 key lock be utilized in place of the hasp and staple if the NEMA 3R rating can be maintained. 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.

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.

Cabinet Layout

Each Communications Cabinet shall be physically divided into two (2) sides by an aluminum back panel that is adjustable in the cabinet depth. The back side will house the power and fiber resources, such as: 120V main power feeding the cabinet, the power conditioner, 6-oulet power strip, equipment power supplies, the fiber termination panel and slack fiber. The front side will house a duplex GFI convenience outlet, and all associated ITS electronics and communication device hardware.

Back Panels

Back panels shall be constructed of 0.10 inch Type 5052-H32 aluminum alloy, unless otherwise specified by the Department. Two back panels and associated mounting hardware shall be included with each communications cabinet and be rated for use in NEMA 3R cabinets. The back panel shall be approximately 1-inch less than the inside dimensions. The back panel shall be 1-inch thick, with air space, to allow for mounting screws to be used from either side without protrusion through the opposing face. The back panel shall be mounted within the communications cabinet with a minimum of four screws on an adjustable sliding channel.

Outlet Box

The communications cabinet shall contain a 4 inch square junction box attached to the back panel and near the door opposing the external service disconnect. 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.

A duplex NEMA 5-15R receptacle shall be provided within the outlet box opposing the external service disconnect. 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.

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REVISION OF SECTION 614
COMMUNICATIONS CABINET (TYPE 2)

Duplex NEMA 5-15R GFCI receptacles shall be provided within the outlet box mounted to the backplane. 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.

Both duplex NEMA 5-15R and duplex NEMA 5-15R GFCI receptacles shall be UL listed.

Power Conditioner

The power conditioner shall be a Clary SP400U Universal 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 (± 3%), user selectable 50 to 60 Hz (± 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) × 11 inches (w) × 8.5 inches depth and its weight shall not exceed 5 lbs. One power conditioner shall be provided with each communications cabinet.

An integral component of the power conditioner shall be a factory-installed power strip. The power strip shall have six front facing NEMA Type 5-15R outlets. 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. The dimensions of the power strip shall be 10 inches (L) × 1.63 inches (W).

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 × 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) × 2.25 inches (w) × 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.

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REVISION OF SECTION 614
COMMUNICATIONS CABINET (TYPE 2)

Service Disconnect. Each service disconnect shall be readily accessible and installed on the exterior of the cabinet close to the door so that the center of the grip of the operating handle of the circuit breaker, when in its highest position, is not more than 6 feet 7 inches above the ground or as required per Article 240.24 of the NEC. The neutral from the power source or service enclosure shall be connected to the ground bar in the service disconnect. The ground bar shall be connected to the service disconnect using a bonding strap.

The ground bar shall be connected to a grounding electrode using grounding conductors conforming to the requirements of Article 250.122 of the NEC. The grounding electrode shall conform to the requirements of Articles 250.52 through 250.70 of the NEC. The service disconnect shall feed a duplex NEMA 5-15R mounted on the inside of the cabinet.

Foundation. Each Communication Cabinet (Type 2) shall include a polymer concrete or poured concrete pad that extends at least 2'-6" beyond the cabinet base on each cabinet door side and at least 6" beyond the cabinet base on the other two sides. There shall also be a raised polymer concrete or poured concrete base. The bottom of this base shall be solidly connected to the pad. The top of the base shall be approximately 2'-0" above the pad and shall include connection mechanisms to which the cabinet can be attached.

CONSTRUCTION REQUIREMENTS

Each communications cabinet shall have tapped pads to provide for the mounting of a back panel as specified herein. Conduit accesses into the cabinet for electrical wiring, specific field device low-voltage control cabling, waveguides and fiber optic cabling, shall be plugged with a manual plug (no foam sealant is allowed). After installation, the top of the cabinet should be approximately 5 feet above the prevailing ground line.

REVISION OF SECTION 614
MICROWAVE VEHICLE RADAR DETECTOR (NON 334)
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.

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REVISION OF SECTION 614
MICROWAVE VEHICLE RADAR DETECTOR (NON 334)

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.

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

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REVISION OF SECTION 614
MICROWAVE VEHICLE RADAR DETECTOR (NON 334)

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

Testing: A local field operations test shall be performed to demonstrate that all hardware, cables, and connections furnished and installed by the Contractor operate correctly and that all functions are in accordance with the requirements described herein. The power supply voltages and the functionality of the cabinet fans and heaters shall be verified. The contractor shall provide CDOT a 5-Day pretest notification and test completion notification. In addition, the Contractor shall prepare a Device Data Sheet (CDOT Form 1411) for each installed device and submit to CDOT.

A subsystem communication throughput test over the communication path between each field device and the communications hub shall be performed. The testing shall occur after all communication installation for a particular site has been completed, the communication paths between the device and the communications hub have been functional for at least 48 hours, and all fiber optic tests have been successfully passed. The Contractor shall notify CDOT at least 7 Days prior to beginning testing.

After successful completion of all subsystem test procedures and after all mainline lanes as well as ramps are open, each site shall be tested for proper functionality and device availablitly for 30 consecutive Days. During the testing period, all equipment at the site that was provided, installed, or relocated by the Contractor shall operate without failures of any type. If any component malfunctions or fails to provide the capabilities specified herein during the 30- Day test period, within 48 hours of notification by CDOT, the Contractor shall troubleshoot to find the exact cause of the failure. The cost of correcting equipment malfunctions shall be the responsibility of the Contractor. After the component malfunction has been corrected to the satisfaction of CDOT, the 30-Day test period shall be restarted.

A CDOT staff member or an authorized CDOT representative shall witness and sign off on all tests.

REVISION OF SECTION 614
WIRELESS MAGNETOMETER VEHICLE DETECTION SYSTEM

Section 614 of the Standard Specifications is hereby revised as follows: Subsection 614.01 shall include the following:

This work includes furnishing and installing wireless battery-powered magnetometer vehicle detection systems in accordance with these specifications at the locations shown on the plans. These systems shall be used at all RMS and CDOT Region 1 ATR stations.

Add subsection 614.08(m) which shall include the following:

(m) *Wireless Magnetometer Vehicle Detection System.* The Wireless Magnetometer Vehicle Detection System (WVDS) shall consist of one Access Point (AP), one or more battery-powered wireless Vehicle Sensor Nodes (VSN) per detection zone, one or more battery powered Wireless Repeaters (RP), one Access Box (AB), one Contact Closure (CC) card, the required number of Extension Interface (EX) cards, and installation materials for each detection zone.

One WVDS is required for each ramp or intersection as indicated on the plans.

The VSN shall detect a vehicle by measuring a change in the earth's magnetic field near the VSN caused by the vehicle (i.e. magnetometer type detection).

The VSN shall transmit detection information within 125 ms of a detected event. The VSN shall automatically recalibrate in the event of a detector lock.

The wireless radio frequency (RF) communications link between the AP, RP, and VSN shall utilize an IEEE-approved wireless communications protocol.

Communications shall use an unlicensed band.

The VSN and RP shall be reconfigurable by a user over the wireless interface to avoid interference from other users of the communications band. A minimum of 16 channels shall be provided for this purpose.

The RF link budget shall be 93dB or greater.

The AP to VSN (or RP to VSN) RF range shall be at least 150 feet for an AP/RP installed at 24 feet above the roadway and at least 100 feet at 18 feet above the roadway.

The RP to AP RF range shall be at least 750 feet when both units are installed 18 feet above the roadway.

Each VSN shall transmit a unique identifying code.

The VSN shall respond within 100 seconds when the AP is powered on.

The AP shall have the capability to transmit detection information to a 170E-HC11 traffic controller to provide real time detection information via a standard contact-closure based input shelf.

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REVISION OF SECTION 614
WIRELESS MAGNETOMETER VEHICLE DETECTION SYSTEM

The VSN, RP and AP shall be capable of accepting software and firmware upgrades.

1. Vehicle Sensor Node Hardware:

   The vehicle sensor node (VSN) shall consist of a 3 Axis magnetometer, a microprocessor, a wireless transmitter and receiver, and a battery.

   The VSN shall have the following characteristics:

   A. components shall be contained within a single housing meeting NEMA 6P and IP68 standards;

   B. components shall be fully encapsulated within the housing to prevent degradation from moisture;

   C. operate in a temperature range from -37 °F to +176 °F;

   D. housing shall be capable of being installed in a 4 inch diameter 2-1/4 inch deep cored hole;

   E. be designed to operate from its battery for a period of 10 years of life under normal traffic conditions after it is put into operation;

   F. be able to transmit the complete X-Y-Z magnetic signature of a vehicle, sampled at a minimum of 128 samples per second. In this mode, the VSN shall be designed to operate from its battery for a minimum of 1 year.

2. Access Point Hardware:

   The access point (AP) shall be the communication hub of the sensor network. The AP shall have the following characteristics:

   A. capable of communicating with up to 24 VSN's;

   B. be powered via 48 V DC, 3W or via non-isolated external 10 to 15 V DC, 2 W power. Power shall be provided by the CC Card;

   C. have at least one powering option that provides 1500 V isolation and 5 KV surge protection;

   D. operate in a temperature range of -37 °F to +176 °F;

   E. meet NEMA 4X and IP67 standards;

   F. weigh 3 pounds or less.

   The AP shall communicate to the controller via the CC and optional EX Contact Closure Board(s).

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REVISION OF SECTION 614
WIRELESS MAGNETOMETER VEHICLE DETECTION SYSTEM

3. Repeater Hardware:

If required, one or more wireless repeaters (RP) shall be provided. The RP shall have the following characteristics:

A. extend the effective communication range of the sensor to the AP an additional 750 feet;

B. be powered by a field-replaceable battery;

C. operate in a temperature range of -37 °F to +176 °F;

D. meet NEMA 4X and IP67 standards;

E. weigh 3 pounds or less.

4. Contact Closure and Extension Interface Contact Closure Cards: The CC and EX cards shall provide detector outputs to the controller.

The CC card shall communicate with the access point via an outdoor rated Cat5e Ethernet cable.

The CC and EX cards shall have the following characteristics:

A. directly plug into standard 170/2070 Input Files and NEMA detector racks;

B. provide up to 4 channels of detection;

C. be capable of providing pulse or presence detection outputs;

D. provide for up to 31 seconds of delay;

E. provide up to 7.5 seconds of extension;

F. be powered by 11 to 26 V DC;

G. be surge protected to GR-1089 standards;

H. operate within a -37° F to +176 °F temperature range;

I. operate in up to 95 percent humidity (non-condensing). The front panel of the CC and EX cards shall provide:

(1) status LEDs displaying detection channel status, line quality, fault monitor;

(2) ten configuration DIP switches to enable presence or pulse mode, delay and extension;

(3) a rotary switch to program time functions for delay and extension functions; and

(4) two Ethernet-style RJ45 connectors.

The CC card shall provide power to the AP over the Ethernet cable.

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REVISION OF SECTION 614
WIRELESS MAGNETOMETER VEHICLE DETECTION SYSTEM

2. Access Box:

The Access Box shall provide a communication link between the AP and the CC card. The Access Box shall have the following characteristics:

A. provide the ability for remote communications;

B. have 3 Ethernet style RJ45 connectors.

C. not exceed 2-3/8 inches by 1-1/2 inches by 7/8 inch in size.

5. Configuration Software:

The WVDS shall include the software necessary to configure the vehicle sensor nodes, wireless repeaters, and access point. The WVDS shall include the software necessary to store and retrieve detection data.

Add subsection 614.10(k) which shall include the following:

(k) *Wireless Magnetometer Vehicle Detection System Installation*. WVDS shall be installed in the configuration shown on the plans.

The vehicle sensor node pavement core shall be circular and shall be made 2 ¼ inches deep and 4 inches in diameter.

The vehicle sensor nodes, access point, repeater, and access box shall be installed in accordance with the manufacturer's guidelines.

REVISION OF SECTION 614
TELEMETRY (MASTER)

Section 614 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

For this project Telemetry (Master) shall include a CDMA cellular modem and associated equipment to provide temporary communications between CDOT and the field device in the event that fiber cannot practically be maintained during construction.

MATERIALS

The wireless cellular data modem shall consist of a hardened modem designed to remotely communicate to serial and Ethernet devices via public Long Term Evolution, LTE, and Code Division Multiple Access, CDMA, cellular networks. The wireless cellular data modem shall consist of a unit capable of transmitting data by its embedded operating system and its own TCP/IP stack to enable transmission of data from non-IP devices. The Wireless Modem shall meet the following minimum requirements:

(1) Communication to Ethernet devices 10/100 RJ-45 Ethernet jack.

(2) Communications to RS-232 serial devices via DB-9F connector at speeds from 300 to 230,400 bps.

(3) Support TCP/IP, UDP/IP, DHCP, HTTP, SNMP, SMTP, SMS, MSCI, NMEA, TAIP , and GPS protocols.

(4) Visual light indicators that show unit status for power, cellular signal, network connection, and data activity.

(5) Cellular network support for LTE at 700MHz and CDMA EV-DO rev A, 1x EV-DO rev 0, or 1xRTT at 800/1900 MHz with options for MIMO in LTE mode or receive diversity in CDMA mode.

(6) Remotely upgradeable PRL, firmware, and configuration.

(7) Minimum EV-DO rev A data rates of 3.1 Mbps downlink and 1.8 Mbps uplink. (8) Built in GPS receiver with port for external antenna.

(9) 50 ohm SMA antenna interfaces.

(10) Operate on 9-36 VDC at 0.5 amps or less.

(11) Operate within a temperature range of -30 to 70˚C at 0 to 95% humidity.

The power supply shall output a nominal 12 volts direct current at a minimum of 2 amps to power the wireless cellular data modem. The power supply shall be rated to operate within a temperature range of -30 to 60˚C.

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REVISION OF SECTION 614
TELEMETRY (MASTER)

The cellular antenna shall be outdoor rated, omnidirectional, and capable of transmitting and receiving on 3 frequency bands: 700MHz for LTE and 800/1900 MHz for CDMA operation. The antenna shall be base or wall mountable.

The antenna cable shall be an RG-58 coaxial cable type rated at 50 ohms. The cable shall be terminated with a male SMA on one end for connection with the wireless cellular data modem. The other end shall be terminated with the correct connector to interface with the tri band antenna.

The communication cable shall be constructed from twisted pair cable with minimum 22 gauge stranded conductors. For Ethernet communication the cable shall be terminated with 8P8C connectors with T568B pin/pair assignments. For serial communication the cable shall be terminated with a DB-9M for interfacing with the wireless cellular data modem. The other end shall be terminated such that it will mate with the designated end equipment.

CONSTRUCTION

The wireless cellular data modem shall be installed in the manor and locations as shown on the plans. A complete installation consists of the wireless cellular data modem, power supply, dual band antenna, antenna cable, communication cable, and wiring power to the unit. The Contractor shall install the power supply to the wireless cellular modem per manufacturer's recommendations. The Contractor shall connect the wireless cellular modem to the designated end equipment as specified in the plans. The placement of the unit shall allow provision for cable installation and maintenance per manufacturer's recommendations. All electrical wiring and connections shall meet NEC standards. The Contractor is responsible for supplying all necessary cabling, connectors, and hardware to make the installation functional.

The Contractor shall provide CDOT ITS with the device ID and login credentials so that CDOT staff can add the device to the network.

The Contractor shall be responsible for the cellular bill and payment during construction

REVISION OF SECTION 614
TELEMETRY (FIELD)

Section 614 of the Standard Specifications is hereby revised for this project as follows.

Subsection 614.01 shall include the following:

This work consists of fan-out and termination of fiber optic (interconnect) cable at each controller cabinet locations as identified in the plans. This work also includes providing and installing all necessary telemetry equipment including but not limited to optical splice closures, field patch panels, splice organizers, cables, pigtails/jumpers and labels.

Color-coded fibers and buffer tubes shall be used throughout the entire project. At the terminal points the jackets shall be stripped and the ends taped. Gel filled compound shall be removed using filled cable cleaner.

At every cabinet or optical closure, only the fibers identified in the plans to be spliced and/or connected to a patch panel or other internal device are required to be landed. All cut and unconnected fibers shall be sealed in a manner recommended by the fiber optic cable manufacturer and coiled neatly in a splice organizer.

The same color-coded pairs of fibers and/or wires shall be used throughout the entire project unless shown as otherwise in the plans. Gel filling compound shall be removed using filled cable cleaner.

Subsection 614.08 shall include the following: Fiber Optic Patch Pigtail:

The fiber optic pigtail cables shall consist of MM fibers housed individually in protective jackets. Both ends of the cable shall be connected. Fiber optic patch cord cable shall be suitable for operation over a temperature range of -30 degrees to +60 degrees Celsius. Fiber optic patch cord cables shall be of length suitably long to be connected between the interconnect panel and the communications equipment (i.e. fiber optic transceivers). Patch cord couplings shall be compatible with termination points. Appropriate strain relief in the cabinet (through cable ties) shall be installed at a minimum of three locations. Sufficient slack shall be left to allow relocation of the equipment anywhere in the cabinet. The attenuation of a fiber optic patch cord cable after installation, not including the connector loss, shall not exceed 0.1 dB measured at 850 nm and 1300 nm.

Connectors:

The connector shall have a ceramic ferrule with a nickel-plated nut and body. The connector shall be an AT&T ST style compatible field mounted connector. The connector shall be compatible with a physical contact (PC) finish. All connectors shall be polished to a PC finish such that the return loss per mated pair of connectors is less than -25 dB. The return loss when the connector is mated with previously installed connectors shall be less than -18 dB.

The connector insertion loss shall not be greater than 0.20 dB (typical). The connector loss shall not vary more than 0.20 dB after 1000 repeated matings. Tensile strength shall withstand an axial load of 20 lb. with less than 0.20 dB change.

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REVISION OF SECTION 614
TELEMETRY (FIELD)

Index matching fluids or gels shall not be used. The connectors shall be compatible with the optical fiber surrounding jacket and shall be installed on one end of the optical fiber in accordance with the manufacturer's recommended materials, equipment and practices. The connector shall be suitable for the intended environment and shall meet the following environmental conditions:

Operating Temperature:	-40° to +80º C
Storage Temperature:	-40° to +85° C

The connector loss shall not vary more than 0.20 dB over the operating temperature range. Connectors shall be protected by a suitably installed waterproof protection cap.

Miscellaneous Cabling:

Fiber optic patch cords shall be fiber optic jumper cable, duplex, ceramic ferrule, MM 62.5 nm, adaptable to AT&T ST style connectors, 2 meters in length, ITT Canon Model 161001-4020 or approved equal. Cable from fiber optic modem to Port 3 controller harness shall be 25-pin cable Model 44982G4 or approved equal. The Contractor shall deliver transceivers to the City's Traffic Signal Shop. Contact Joe Strauss (720) 865-4062 for coordination.

Optical Splice Closures:

Coyote Runt or Coyote Pup Type closures shall be provided for splicing lateral fiber optic cables to the main (backbone) fiber cable in all pull box locations that are identified in the plans. All closures shall include 1-Inch future port kit (part no. 8003408, Pre- Formed Line Products). The Coyote Runt Closure shall be used at locations with 3 fiber optic cables. In locations requiring more than 3 cables, a Coyote Pup Closure shall be installed.

Subsection 614.13 shall include the following:

Telemetry (Field) shall be measured by the total number of cabinets at which the interconnect cable is fanned out, terminated, connected, patch panels and fiber-optic interfaces installed. All labor and materials required to perform panel installations including but not limited to fiber optic cables, provide in-cabinet strain relief, fan-out, cable termination and connection to the controller is considered included in the unit price for this item.

This item, therefore, includes the following:

1. All required in-cabinet cable ties and strain relief (including ancillary hardware and labor to complete);

2. All required fan-out kits, kit tools, ancillary hardware and labor to accomplish the fan-out at the cabinet;

3. All required pigtails and harness cables;

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REVISION OF SECTION 614
TELEMETRY (FIELD)

4. All required interconnect centers and fiber optic interface panels in individual controller cabinets as shown in the plans;

    - All required termination enclosures (including specified features), connectors, adapters, jumpers, pigtails, patch cord cables, ancillary hardware and labor required to accomplish the cabinet termination;
    - All required optical splice closures;
    - All other labor and material necessary to complete the item

All labor and materials necessary to complete this item shall be considered included in the unit price and will not be paid separately.

REVISION OF SECTION 614
CCD LOOSE TUBE FIBER OPTIC CABLE

Section 614 of the Standard Specifications is hereby revised for this project as follows.

Notice:

Every effort has been made to ensure that the information contained in this specification is complete and accurate at the time of publication; however, information contained herein is subject to change.

Trademarks:

ANSI® is a registered trademark of the American National Standards Institute, Inc. KELLEMS® is a registered trademark of Harvey Hubbell, Inc.

Scope:

This specification covers the general design requirements and performance standards for fiber optic cables intended primarily for use in the outside plant environment. The purpose of this document is to provide the essential requirements for All-Dielectric Single Jacket, Single Jacket / Single Armor, and Double Jacket / Single Armor Loose Tube Fiber Optic cable to be used in the City of Denver networks.

The product requirements and features described in this specification are those considered useful for ensuring proper selection and manufacturing of fiber optic outside plant cables.

In this specification, all observed or calculated values are rounded off "to the nearest unit" in the last right hand place of figures used in expressing the limiting value. The round-off method of ASTM E 29 is used.

These cables should comply with industry standards such as Telcordia Technologies GR-20 (formerly Bellcore), Electronic Industries Association (EIA), Telecommunications Industry Association (TIA), International Telecommunications Union (ITU), International Electrotechnical Commission (IEC), and American Society for Testing and Materials (ASTM).

Optical Fiber Characteristics

High quality optical fibers should be made with pure silica-based glass to have very low loss for infrared wavelengths and to be used to carry large amounts of information for very long distances in optical communication systems.

Details of the optical fibers are not covered in this specification, but the proposed cable should contain AllWave® or TrueWave® fibers for Single-Mode applications, or Multimode fibers that comply with the specific fiber requirements supplied by the City of Denver.

Cable Core Characteristic:

1. Color Code:

   The individual colors for fibers and buffer tubes in loose tube cable cores should comply with EIA/TIA-598 as given in the following table.

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Table 1 – Fiber and Tube Color Code

Fiber or Tube No.	Color
1	Blue (BL)
2	Orange (OR)
3	Green (GR)
4	Brown (BR)
5	Slate (SL)
6	White (WH)
7	Red (RD)
8	Black (BK)
9	Yellow (YL)
10	Violet (VI)
11	Rose (RS)
12	Aqua (AQ)

2. Central Strength Member

The central member functions as an anti-buckling element, and should be a glass/epoxy composite dielectric rod. A polyethylene overcoat may be applied to the central member to provide the proper spacing between buffer tubes during stranding.

3. Loose Tube Cable Buffer Tubes

Optical fibers are enclosed within buffer tubes that have a diameter several times larger than the diameter of the fibers. The optical fibers are loose within the buffer tubes allowing the fibers to move freely. The loose buffer tubes should have a 2.5 mm diameter, with a nominal wall thickness of 0.4 mm. For composite cable designs when both and multi-mode fibers are contained within the same cable, the single-mode fibers will be contained in the first buffer tubes. The multi-mode fibers will be contained in the sequenced buffer tubes following the multi-mode buffer tubes.

Table 2 – Buffer Tubes

Fiber Count	Buffer Tube OD (mm)	Fibers per Tube
1-288	2.5	12

The buffer tubes (and filler rods, if necessary) must be stranded in a reverse oscillation lay (ROL) technique around the central member to allow for easy mid-span access. The core of buffer tubes should be wrapped with two counter helically applied threads to bind together the cable core.

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4. Filler Rods

In order to create a round cable, filler rods of the same diameter as the buffer tubes may be used to fill empty positions. Filler rods are made out of HDPE and are natural in color.

5. Water Blocking System

Water blocking of the core outside and around the buffer tubes must be accomplished via "dry" elements. **In addition, water-blocking inside the buffer tubes must be accomplished via "dry" elements as well.**

These "dry" water blocking elements form a gel compound when in contact with water. The gel should effectively fill the interstices of the core and the inside of the tubes to prevent water penetration along the length of the cable. This dry water blocking significantly reduces cable core access time by eliminating the step of cleaning the buffer tubes and fibers upon entry. Additionally, this technology reduces the cable weight.

Dry water blocking elements should be in the form of binders, tapes, or yarns depending on where they are being applied.

Cable Sheath Characteristic:

The sheaths described in this section are:

- All-Dielectric Single Jacket: One polyethylene jacket, no metallic elements (SJ)
- Strength Elements: Sheath strength elements are applied over the cable core to provide the cable with the required tensile strength. These elements are made of fiberglass (Aramid yarns may be used as well).
- Inner Jacket (NOT APPLICABLE TO THIS PROJECT)
- Steel Armor (NOT APPLICABLE TO THIS PROJECT)
- Outer Jacket: An outer polyethylene jacket is applied over the cable to provide overall mechanical protection. This jacket is made of MDPE (or HDPE upon request) and is usually black. If required, the jacket could have two co-extruded colored tracer stripes located 180 degrees apart to aid in cable identification. The jacket will be continuous, free from pinholes, splits, blisters, or other imperfections.
- Ripcords: For ease of jacket removal, one clearly identifiable polyester ripcord is provided under the outer jacket for SJ designs. SJ/SA designs shall have two under armor ripcords placed 180 degrees apart. DJ/SA designs shall have one ripcord under both the inner jacket and steel armor.

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Cable Cross-Sections: Single Jacket (SJ)

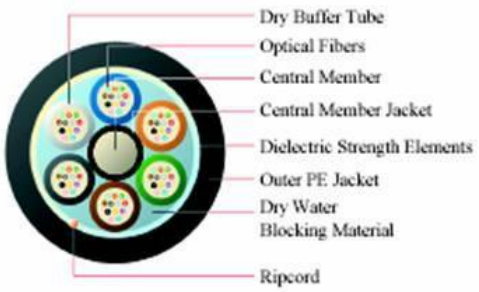

Figure 1 – Single Jacket

Table 3 – Target Cable Outer Diameters

	Number of Fibers							
	2 - 60 (5 Pos.)	**2 - 72 (6 Pos.)**	**73 - 96 (8 Pos.)**	**97 - 120 (10 Pos.)**	**121- 44 (12 Pos.)**	**145-216 (18 Pos.)**	**217-240 (20 Pos.)**	**241-288 (24 Pos.)**
Sheath Type	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)
SJ	0.42 (10.6)	0.43 (11.0)	0.50 (12.8)	0.57 (14.4)	0.64 (16.2)	0.66 (16.7)	0.69 (17.4)	0.76 (19.2)

Mechanical, Environmental and Electrical Requirements:

These cables must meet the requirements of *Telcordia GR-20-CORE* with all testing performed based on *EIA/TIA-455* standards. The manufacturing company must provide proof of their quality control standards with *ISO 9001* and *TL9000* certifications. The cables should comply with the following temperature ranges:

Operation:	-40°C to 70°C (-40°F to 158°F)
Installation:	-30°C to 60°C (-22°F to 140°F)
Storage/Shipping:	-40°C to 75°C (-40°F to 167°F)

Single-Mode Fibers

Per *Telcordia GR-20*, the magnitude of the attenuation change shall be less than or equal to 0.05 dB for 90% of the test fibers and less than or equal to 0.15 dB for the remaining 10% of test fibers. Cable aging allows for 0.10 dB/km average attenuation change with a magnitude of the maximum attenuation change for each individual fiber to be less than 0.25dB/km. These attenuation values include a 0.05 dB allowance for measurement repeatability During mechanical and environmental testing evidence of cracking, splitting or other failure of the sheath components when examined under 5X magnification would result in failure of the proposed test requirements. In addition, no fiber shall lose optical continuity because of the test.

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Table 4 – Testing for Single Mode Fibers

Cable Test	Test Method	Requirement
Tensile Loading and Bending	EIA/TIA-455-33 IEC 794-1-E1	90% < 0.05 dB Max. Added Loss 100% < 0.15 dB Max. Added Loss
Cyclic Flexing	TIA/EIA-455-104 IEC 794-1-E6	90% < 0.05 dB Max. Added Loss 100% < 0.15 dB Max. Added Loss
Cyclic Impact	EIA/TIA-455-25 IEC 794-1-E4	90% < 0.05 dB Max. Added Loss 100% < 0.15 dB Max. Added Loss
Compressive Loading	TIA/EIA-455-41 IEC 794-1-E3	90% < 0.05 dB Max. Added Loss 100% < 0.15 dB Max. Added Loss
Twist	TIA/EIA-455-85 IEC 794-1-E7	90% < 0.05 dB Max. Added Loss 100% < 0.15 dB Max. Added Loss
Low and High Temperature Bend	EIA/TIA-455-37 IEC 794-1-E11	90% < 0.05 dB Max. Added Loss 100% < 0.15 dB Max. Added Loss
External Freezing	EIA/TIA-455-98 IEC 794-1-F6	< 0.05 dB Mean Added Loss < 0.15 dB Max. Added Loss
Temperature Cycling	EIA/TIA-455-3 IEC 794-1-F1	< 0.05 dB/km Mean Added Loss < 0.15 dB/km Max Added Loss
Cable Aging	EIA/TIA-455-3 IEC 794-1-F1	< 0.10 dB/km Mean Added Loss < 0.25 dB/km Max Added Loss
Water Penetration	EIA/TIA-455-82 IEC 794-1-F5	No flow after 24 hours from one meter length of cable

Multimode Fibers

Per *Telcordia GR-20*, the allowable attenuation increase during the mechanical and environmental testing is 0.20 dB. Cable aging allows for the maximum attenuation change for each individual fiber to be less than 0.40dB/km.

During mechanical and environmental testing evidence of cracking, splitting or other failure of the sheath components when examined under 5X magnification would result in failure of the proposed test requirements. In addition, no fiber shall lose optical continuity because of the test.

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Table 5 – Testing for Multi-Mode Fibers

Cable Test	Test Method	Requirement
Tensile Loading and Bending	EIA/TIA-455-33 IEC 794-1-E1	0.20 dB Max. Mean Added Loss
Cyclic Flexing	TIA/EIA-455-104 IEC 794-1-E6	0.20 dB Max. Mean Added Loss
Cyclic Impact	EIA/TIA-455-25 IEC 794-1-E4	0.40 dB Max. Mean Added Loss
Compressive Loading	TIA/EIA-455-41 IEC 794-1-E3	0.20 dB Max. Mean Added Loss
Twist	TIA/EIA-455-85 IEC 794-1-E7	0.20 dB Max. Mean Added Loss
Low and High Temperature Bend	EIA/TIA-455-37 IEC 794-1-E11	0.40 dB Max. Mean Added Loss
External Freezing	EIA/TIA-455-98 IEC 794-1-F6	0.20 dB Max. Mean Added Loss
Temperature Cycling	EIA/TIA-455-3 IEC 794-1-F1	< 0.5 dB/km Max Added Loss 80 % < 0.25 dB/km Added Loss
Cable Aging	EIA/TIA-455-3 IEC 794-1-F1	< 1.0 dB/km Max Added Loss 80 % < 0.5 dB/km Added Loss
Water Penetration	EIA/TIA-455-82 IEC 794-1-F5	No flow after one hour from one meter length of cable

Note:

The tensile rating for all of the cables described should be 2.7 kN (600 lbf), with a compression rating of at least 220 N/cm under GR-20 requirements.

Cable Marking

Printed Characters

For standard outer jackets, printed characters shall be indent printed with white characters for black jackets, black characters for non-black jackets, or as otherwise specified.

For standard striped outer jackets, printed characters shall be indent printed with white characters for red, green, orange, yellow, blue striped cables, light-blue characters for white striped cables, or as otherwise specified by the customer.

The characters shall be of proper height and space to produce good legibility. Character heights of

2 mm should facilitate adequate readability. An occasional illegible marking is permitted if there is a legible marking on either side.

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Markings

The cable shall be sequentially marked at one meter, or two-foot intervals depending on specific requirements issued by the City of Denver. The length marks shall not be reset to zero on any length of the cable. The actual length of cable shall be within +1, -0% of the marked length.

Each length of cable shall be marked with the following legend:

"(Manufacturer Name) OPTICAL CABLE, (Product Part Number), (Month and Year of Manufacture, [MM-YY]), (Telephone Symbol [ ]), (Fiber Count [XXX F], where XXX is the number of optical fibers in the cable), and (Manufacturers' Serial Number) "

Re-Markings

Only one remarking is permitted. If required, either of the following methods for remarking shall be used:

Method A: Completely remove the defective marking and remark the characters with the original color.

Method B: Leave the defective marking on the jacket and remark on a different portion of the cable jacket with yellow character print. The new number sequence shall differ from any other existing marking by at least 5000.

Any cable that contains two sets of markings shall be labeled to indicate the color and sequential numbers to be used. The labeling shall also be applied to the reel tag.

Cable Packaging

Reels

The manufacturer shall supply the product using their standard reel sizes, methods, apparatus, and reel wood lagging, but stenciled according to these specifications. The specifications outlined here are guidelines on what is expected with respect to packaging.

Reels are assumed to be in good working condition, firm, and be able to support the product through shipping and final installation. Reels shall be clean, dry and free of excessive dirt. All reels shall be checked for high nails, stave fit and proper stenciling.

Reel Labels

Each wooden reel shall be permanently marked with the following information:

- "(Manufacturer's name)" (red paint)
- "OPTICAL CABLE" (black paint)

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- An arrow and the wording “cable end” to indicate the position of the outside cable end. (red paint)
- An arrow and the wording “ROLL THIS WAY” to indicate the direction the reel should be rolled to prevent loosening of the cable. (black paint)
- Reel Number (red paint)

Cable handling stickers/cards must be attached to both flanges of every reel. Each sticker must be stapled to the flange. See Figure 4 for illustrations of the stickers to be used.

Reel Lagging

Thermal Protection

Outer layers of the reel shall be covered with a protective wrap to limit the solar heating of the cable. This helps limit the cable surface temperature so that it will not exceed 10 C (18 F) above ambient temperature under maximum solar radiation according to Telcordia GR-20 requirements.

All foil wrap shall be securely fastened to the cable by at least 2 pieces of strapping tape.

Composite & Wood Lagging

Reels shipping domestically shall be lagged with a suitable protective wrap (can be the same thermal protection wrap) and banded with steel straps. This wrap shall cover the cable from flange to flange and provided some mechanical protection to the outer layers of cable as well as weather resistance. Reels shipping for export shall be lagged with wooden boards nailed to each flange and banded with steel straps in addition to the protective wrap around the outer layers of cable.

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Figure 4 – Reel Stickers

Other

Cable Ends

Each end of the cable shall have end seals, either end caps or KELLEMS® pulling grips, in order to prevent moisture ingress into the cable during shipping, storage, or installation.

The top end of the cable shall be securely fastened to the inside of the reel flange to prevent the cable from becoming loose in transit or during handling. The bottom end, "test tail", shall be approximately three meters in length and easily accessible. The end shall be protected within a cable slot and be securely fastened to the outside of the reel flange with wire ties or walkout straps. Staples, nails or yarn attached to the reel during manufacturing shall be removed.

The cable slot can be partially protected to prevent the cable tail from moving outside this, however for export orders the cable slot must be completely sealed by either metallic protection rings, plywood covers, or other.

Cable Length Tolerance

Cables ordered to standard factory lengths shall have an actual length within –0% and +5% of the length ordered unless otherwise specified by the customer.

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Certified Test Data

Each cable shall have certified test data securely fastened to the reel in a waterproof wrapping. The certified test data sheet shall include the following information:

- Cable Number
- Date
- Customer Name
- Ordered Length
- Customer Order Number
- Ship Length
- Customer Cable Code
- Customer Reel Number
- Customer's Attenuation Specification(s)
- Number of Fibers
- Cable Construction
- Fiber Transmission Data
- Bandwidth Data – only applies to Multi-Mode Fibers
- Authorized Signature

Reel Tag

Each cable shall have a reel tag securely fastened to the reel in a waterproof wrapping. The Reel Tag (Cut Length Data Sheet) shall include the following information:

- Cable Number
- Date
- Customer Name
- Ordered Length
- Customer Order Number
- Ship Length
- Customer Cable Code
- Customer Reel Number
- Customer's Attenuation Specification(s)
- Number of Fibers
- Beginning and Ending Sequential Length Markings
- Gross Weight
- Net Weight
- Inspected By Signature

REVISION OF SECTION 614
SERIAL TO IP CONVERTER

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

This work consists of furnishing and installing a 4-port, hardened serial-to-IP terminal server as shown on the plans. The serial-to-IP converter shall be used to convert serial data to IP Ethernet for use with an IP Ethernet network.

MATERIALS

The serial-to-IP converter shall have four serial port connections which convert serial data to an Internet Protocol (IP) network over a single TCP/IP connection of 10/100 Mbps. The converter shall be stand alone. The converter shall have the capability of operating with a temp range of -35 degrees C to 74 degrees C. A power supply shall be provided for each unit to make the unit wholly functional.

Cables shall be provided for connection to the end equipment and in turn to the Ethernet switch. Serial connection shall be appropriately mated to the end equipment on one end and a RJ-45 male connector on the other. Connections to the Ethernet switch shall be by Ethernet CAT-5e cabling with RJ-45 connectors on both ends. Cable length shall be sized accordingly to allow connectivity between the unit and device, plus nominal slack.

The converter shall support RS-232, RS 422, and RS-485 serial communications at baud rates of up to 230 Kbps throughputs on all ports with up to 64 Kbps of port buffering. All ports shall have TCP and UDP socket support.

Converter shall be supplied with software for configuring the unit and communication ports using Windows operating systems.

CONSTRUCTION REQUIREMENTS

The Contractor shall furnish and install the unit, power supply, and all cabling necessary for the Serial to IP Converter. This shall include all cable termination and copper wiring using current industry standards for cable management and workmanship techniques.

All cables shall be labeled on both ends indicating the individual connections. Labels shall be vinyl, self-laminating type with black lettering on a white background.

The serial-to-IP converter shall be installed in accordance with the details in the plans and in accordance with manufacturer’s recommendations.

REVISION OF SECTION 614
FOLD-OVER TOWER (ITS)

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

This work consists of furnishing and installing a heavy duty fold over tower, base assembly, concrete footing, concrete pad, and chain link fencing at the locations shown on the Plans.

MATERIALS

The heavy duty fold over tower and base assembly shall be a Heavy Duty Fold over Tower – Model MF 1333, 30 feet in height as supplied by Glen Martin Engineering, Inc., 13620 Old Hwy 40, Boonville, MO., 65233, (660) 882-2734. (www.glenmartin.com) or equivalent.

Concrete footing shall be Concrete Class BZ and shall be in accordance with Section 601.

Chain link fencing shall be a minimum of 5ft and no more than 7 ft tall when measured from ground level.

CONSTRUCTION REQUIREMENTS

The heavy duty fold over tower and base assembly shall be installed in accordance with the details shown in the Plans and in accordance with manufacturer's recommendations. The tower shall be installed such that it will not become an obstruction or hazard when raised, lowered, or in the fold down state. A 7'6" x 7'6" x 4" deep concrete pad shall be formed and poured after the tower footing has been installed. The pad shall be poured such that the tower footing is located in the center of the pad. All incoming conduits shall be cast directly in the concrete pad and/or footing. The Contractor shall install chain link fencing around the outside perimeter of the concrete pad. This chain link fencing shall be installed within 6" to 2' of the edge of concrete all along the perimeter. A 3' 6" to 4' gate shall be added along with locking hasps and end-caps. This gate shall be centered opposite the hinged side of the tower to allow access for the fold down tower to retract and be maintained.

The Contractor shall make all arrangements for a qualified manufacturer's representative to be on-site to ensure proper installation. The Contractor shall perform an acceptance test procedure for approval and acceptance by the Department in the presence of the Project Engineer and a representative of the CDOT ITS department. The acceptance test shall include demonstrating the tower raises and lowers according to the manufacturer's design and is fully functional at completion.

METHOD OF MEASUREMENT

Fold over tower (ITS) will be measured by the actual number of heavy duty folding towers that are installed and accepted, and will include a complete installation including, shipping, base assembly, excavation and backfill, concrete footing, chain link fence, and finish grading to match the existing terrain.

REVISION OF SECTION 614
FIBER OPTIC PRE-CONNECTORIZED CABLE

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of the installation of fiber optic pre-connectorized patch cables in communication cabinets, variable message signs and communications node buildings from the termination patch panel to the optical communication device optics.

At Ethernet switch locations, coarse wavelength division multiplexing (CWDM) is to be utilized and shall require bend insensitive fiber optic pre-connectorized patch cables. Bend insensitive pre-connectorized patch cables shall also be required for CWDM optical connections in communications node buildings.

The bend insensitive cable shall be used to enable a tight bend radius and routing to help alleviate data loss.

MATERIALS

The measured attenuation of the connector (inclusive of coupler and mated test connector) shall not exceed an average of 0.3 dB for all connectors provided. Any connector found in excess of 0.5 dB shall be rejected. Reflectance shall be less than -40 dB from 14º F to 140º F (-10ºC to +60ºC). The manufacturer shall have a program that periodically tests connectors to ensure than after 1000 re-matings, the attenuation will not change more than 0.2 dB.

The measured insertion loss shall be a maximum of 0.25 dB with a typical loss of 0.15dB. Return loss shall be a maximum of -65 dB (APC) and -55 dB (UPC) with a typical loss of -68 dB (APC) and -58 dB (UPC). The minimum cable bend radius shall be less the 15 mm.

The connector shall be able to withstand an axial pull of 25 lbs. with no physical damage to the connector and no permanent optical degradation more than 0.3 dB.

The CWDM pre-connectorized cables shall be jacketed for extra protection and shall be provided with pre-connectorized connectors on both ends to match the termination patch panel bulkheads and coarse wavelength division multiplexing, small form-factor pluggable optic modules of the Ethernet switch. Connectors shall be terminated by the manufacturer.

The connectors shall be nickel-plated with a ceramic ferrule and shall be polished with a physical contact (PC) finish end to reduce reflection.

The bend insensitive pre-connectorized patch cable shall meet the following specifications:

Patch Cable Connectors

(1) EIA, TIA-55 (FOCIS)

(2) UL94 V-O

(3) GR-326, Issue 3 Specifications

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REVISION OF SECTION 614
FIBER OPTIC PRE-CONNECTORIZED CABLE

Fiber Cable

(1) Telcordia GR-409

CWDM patch cable bend insensitive fiber shall satisfy International Telecommunication Union (ITU) -T G.657 category A1 standards. The cable shall have a 'tactical' polyurethane jacket to resist bending.

The cables shall contain the exact number of loose tube fibers and bulkhead connectors to connect from the termination patch panel to the optical modules. If the optical equipment transmits and receives data with a single optic, the pre-connectorized cable shall contain a single optical fiber, (simplex). When the optical device transmits and received data with two or four optics, or a network Ethernet switch small form factor pluggable optic module, a pre-connectorized cable shall be provided with 2 (two) optical fibers, (duplex) per pair of transmit and receive optics.

CONSTRUCTION REQUIREMENTS

Pre-connectorized cables shall be installed from the termination panel bulkheads to the optical modules of the communication devices.

At the communications node building, the pre-connectorized cables shall be installed in the cable management hardware attached to equipment racks. The Contractor shall provide patch cables of sufficient length to span from the fiber termination patch panel bulkheads to the communications device or network device optical port. This length shall include a maximum of four (4) feet of slack cable. Appropriate cable management shall be used.

At communication cabinets, the Contractor shall provide pre-connectorized cables of sufficient length to span from the fiber termination patch panel bulkheads to the equipment device or network device optical port. This length shall include a maximum of two (2) feet of slack cable. Appropriate cable management shall be used.

Prior to installation, all pre-connectorized cable bulkhead connectors shall be cleaned with lint-free fiber wipes moistened with Isopropyl Alcohol 99% U.S.P. After cleaning with alcohol, the bulkhead shall be cleaned with an optical connector cleaner to ensure that all residue is removed.

Manufacturer testing reports for pre-connectorized cables shall be submitted as part of the as-built documentation. The installation location shall be noted on the test report for future reference.

At communication node buildings, pre-connectorized patch cables shall have identification labels applied on each end. Information indicating the patch panel number, device boing connected, CWDM wavelength and Ethernet switch port number. CDOT personnel will aide in the labeling as it pertains to the proper nomenclature to be provided and/or Ethernet port connectons.

At all field device locations, each cable shall have individual labels indicating the CWDM wavelength, termination panel port and the data transmitting description, (example: Tx or Rx).

Patch cable labeling shall be as shown on the Project Detail Sheet.

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FIBER OPTIC PRE-CONNECTORIZED CABLE

The pre-connectorized cables shall be provided in the following lengths.

Field Device Cabinets ..... 4 Feet – 0 Inch maximum

Node Buildings ..... Cable shall be of sufficient length to accommodate connection of termination patch panel bulkhead to each individual optical device while allowing for 4 feet of slack.

METHOD OF MEASUREMENT

Fiber optic pre-connectorized cables and labeling will not be measured or paid for separately but will be considered subsidiary to the individual communications device or Ethernet switch item and shall include all labor, materials and equipment required to complete the work. Also included shall be all information labeling in the communication node building and in field device communications cabinets.

REVISION OF SECTION 614
FIBER OPTIC SPLICE CLOSURE

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This item includes installing fiber optic splice closures and performing splicing of both fiber optic backbone and fiber optic lateral cables at locations shown on the plans.

MATERIALS

The fiber optic splice closures shall be furnished and installed by the Contractor.

The splice closures shall be dome type and shall meet the following minimum requirements:

(1) The closures shall seal, anchor and protect fiber optic cable splices.

(2) The closures shall have a minimum of six total cable entries.

(3) The closures shall be suitable for underground applications and shall be corrosion resistant, watertight and airtight.

(4) The closure splice trays shall have a hinged design with an upright locking mechanism for all splice trays.

(5) The closures shall have a sealing design that does not require glue, sealant, or new cable seals to re-enter the closure.

(6) The closure shall be bonded inside and outside and have an external ground lug.

(7) The Contractor shall include all necessary accessories to complete splicing.

(8) The Contractor shall include all mounting hardware

(9) The splice closure shall comply with Telcordia Generic Requirement (GR) GR-771

The closures shall be sized to provide a capacity equal to the total number of strands for all cables entering the closure.

CONSTRUCTION REQUIREMENTS

The Contractor shall notify the Project Engineer of proposed daily splicing locations two business days prior to splicing and also the morning of proposed splicing. The Contractor shall contact the Project Engineer at least four hours prior to sealing the closure to allow inspection.

If the Project Engineer cannot be on site to inspect the open splice closure, a minimum of eight digital pictures shall be taken at varying angles of the interior of the splice closure showing all completed work as stated in this specification and shown on the Project Detail Sheet. The pictures shall include exposed fiber stands (both spliced and uncut) in all splice trays, fiber tray labeling and remaining buffer tubes showing appropriate coiling. One picture shall also include the complete re-assembly of all interior parts

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REVISION OF SECTION 614
FIBER OPTIC SPLICE CLOSURE

prior to final sealing. Once the closure and fiber coils are installed in the pull box or manhole, two pictures shall be taken showing the final installation of both the closure and the coiled fiber cable attached to the fiber management hardware. All pictures shall be organized per location and shall be submitted to the Project Engineer along with all final testing result documentation.

All splices shall be performed using the fusion splicing method. The fusion splicer shall be calibrated and certified at least once within the previous year from this project. The Contractor shall present all certification documentation to the Project Engineer prior to start of fiber splicing.

The optical fibers shall be fusion spliced and shall meet the requirements in the Revision of Section 614 – Test Fiber Optic Cable special provision.

The Contractor shall label each individual splice and buffer tube in all splice trays per the Project Detail Sheet included on the plans.

The Contractor shall cut and splice only those fiber strands shown to be spliced on the fiber splicing plan sheets. All unused buffer tubes and fiber strands shall remain uncut. After the fiber cable and proposed buffer tube is prepped for splicing, all fiber strands in the buffer tube shall be cleaned of all homogeneous gel, unless gel-free buffer tubes are used. All uncut fiber strands shall be coiled in the tray. Remaining buffer tubes shall be neatly coiled, secured and stored in the storage area within the closure under the splice trays per the manufacturer's recommendations. Buffer tubes proposed for splicing shall be wrapped and secured to the splice tray with ties per the manufacturer's recommendations.

Bare fiber strands shall not be taped to the splice tray.

All fiber optic cables shall be secured and sealed at the closure entrances. All unused cable entries shall be plugged.

If the closure requires re-entry, it shall be conducted per the manufacturer's recommendation for re-entry and resealing. The Contractor shall use caution to prevent damage to the existing fiber strands, splices, and buffer tubes inside the splice closure. When sealing the closure for a second time, the Contractor shall follow all re-entry requirements of the manufacturer.

The Contractor shall ensure that the fiber optic splice closures and associated fiber cable coils fit adequately within the manhole or pull box splice locations shown on the plans, and shall securely mount the splice enclosure to the side of the manhole as shown on the project plans.

METHOD OF MEASUREMENT

Fiber Optic Splice Closure and all associated materials will not be measured separately but will be considered subsidiary to the Fiber Optic Cable (Single Mode) pay item.

BASIS OF PAYMENT

Fiber Optic Splice Closure and all associated materials will not be paid for separately but will be considered subsidiary to the Fiber Optic Cable (Single Mode) pay item. The item shall include all

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REVISION OF SECTION 614
FIBER OPTIC SPLICE CLOSURE

accessories necessary to complete fiber optic splicing and all mounting hardware necessary to secure the splice closure to the manhole.

REVISION OF SECTION 614
FIBER OPTIC TERMINATION PANEL

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing fiber optic termination panels in communication cabinets for single mode fiber optic cables.

MATERIALS

All termination panels shall be manufactured using aluminum and shall be finished with powder coat. The termination panels shall accommodate lateral fiber optic cables as shown on the plans. All termination panels shall be equipped with six port Straight Tip (ST) type bulkheads and be compliant with the Telcordia Technologies Generic Requirement (GR) GR-326 *Generic Requirements for Single-Mode Optical Connectors and Jumper Assemblies, Latest Issue*. The manufacturer shall perform acceptance testing for insertion loss and return loss with the test certification provided with each patch panel.

All termination panels shall have a labeling scheme that complies with details as shown on the plans.

All termination panels shall be compatible with the fiber optic cable being terminated.

The six port panels shall have hinged doors that provide access to both the fiber fan out and the termination bulkheads. The panel shall be sized to accommodate the entry of the lateral fiber optic cable, fiber fan out, and bulkheads with the access door closed. The fiber optic patch panel shall be suitable for wall mounting. Dimensions shall not exceed 5 inches wide × 6 inches long × 2 inch deep. Each fiber optic patch panel shall include a fiber adapter panel, adapters, field termination and polishing of fiber), strain relief, grommet tape, zip ties and wall mounting bracket. Terminations within the patch panel shall be polished with a physical contact (PC) finish.

24 port termination panels for lateral fiber optic cables shall be provided to accommodate 24 ports. 24 port termination panels shall be compatible with a 19-inch equipment rack. The panels shall be provided with two six port ST type bulkheads. The panel shall be provided with covers for the remaining spaces. The termination panel shall have a slide out interior.

Bulkheads in all termination panels shall be metal. Plastic bulkheads will not be accepted.

CONSTRUCTION REQUIREMENTS

Six port termination panels for lateral fiber optic cables shall be installed at locations where either existing or proposed equipment does not allow for the installation of a 24 port termination panel.

24 port termination panels shall be installed within communications cabinets and shall be mounted in locations that allow for ease of access and shall not interfere with maintenance of the internal equipment. 24 port termination panels shall be installed in communications cabinet 19 inch equipment racks.

Fiber terminations shall be as shown on the plans. The contractor shall field terminate ST type bulkhead connectors on the ends of the lateral fiber cable strands and install them on the back side of the termination panel. The terminated connectors shall be nickel-plated with a ceramic ferrule and shall be polished with a physical contact finish. Buffer tube fan-out kits shall be paid for in accordance with the Revision of Section 614 – Buffer Tube Fan-Out Kit.

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REVISION OF SECTION 614
FIBER OPTIC TERMINATION PANEL

Instead of field terminating and polishing lateral fiber optic cables, the Contractor may use a single mode fiber pigtail that is factory terminated on six port ST type bulkhead and fusion splice the pigtail to the lateral fiber optic cable. If this method is used, the termination panel shall be sized and configured to accommodate splicing of the pigtail.

The Contractor shall use proper strain relief inside the termination panel for the fiber cable and fiber fan out strands per the manufacturer's recommendations. The use of tape to secure the individual fanned out strands to the bottom of the termination panel shall not be allowed. The contractor shall allow enough slack in the terminated fiber to allow for opening and closing the termination panel without disturbing the terminated fiber.

All hardware shall be installed in accordance with manufacturer's recommendations.

METHOD OF MEASUREMENT

Fiber Optic Termination Panels will be measured by the actual number of fiber optic termination panels installed and accepted and shall include all bulkheads, field terminations, covers for empty bulkhead entries, labeling panels and all materials, hardware, labor and equipment necessary to complete the work.

REVISION OF SECTION 614
AUTOMATIC TRAFFIC RECORDING STATION

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

This work consists of furnishing and installing a Phoenix II Diamond counter, Wavetronix SmartSensor HD126 side- fire radar unit, CDMA cellular modem, and associated equipment, to make a complete CDOT DTD Automatic Traffic Recording (ATR) Station. This also includes providing a cabinet sized to house all components for the ATR station.

MATERIALS

The ATR Station materials shall include:

The Wavetronix SmartSensor 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.

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 CDMA cellular modem shall be furnished, installed, configured, and tested, and the Contractor shall establish communications from the DTD central system to the field ATR.

A Wavetronix Series 100 Click module shall be furnished and installed, along with any cabling, to interface with the Phoenix II Diamond counter. The series 100 module shall be DIN rail mountable.

A mini power supply, circuit breaker, and a Wavetronix Series 205 Click module shall be furnished and installed and each shall be DIN rail mountable.

Serial surge suppressor shall be provide and be a 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.

The Phoenix II Diamond traffic counter shall be furnished and installed, along with any cabling and hardware necessary. The counter shall be capable of counting a minimum of 6 lanes.

Additional hardware, including but not limited to: mounting hardware and data interconnection cables shall be provided.

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REVISION OF SECTION 614
AUTOMATIC TRAFFIC RECORDING STATION

CONSTRUCTION REQUIREMENTS

A minimum of five days prior to installation, the contractor shall submit a schedule of installation activities including alternative scheduling to the CDOT Project Manager and the Traffic Data Collection (TDC) Manager (Mike DelCupp, 303-757-9816, mike.delcupp@state.co.us). The installation instructions from the manufacturer shall also be submitted for approval.

The contractor shall provide a CDMA modem to the ATR cabinet for connection to DTD and shall also provide a pole- mounted cabinet for the traffic counter. The pole-mounted cabinet shall be NEMA 4R rated and shall be sized adequately to house all of the ATR Station components, such as the counter, CDMA modem, Wavetronix equipment, power supplies, cabling, and wiring.

All work will be inspected by the Traffic Data Collection Unit (TDC) during installation. Acceptance will be based on the testing and operation of the Wavetronix SmartSensor and Phoenix Diamond Counter under actual traffic conditions, in which one week of actual data will be collected. The volume and vehicle class shall be within ±10 percent for the site compared to historical data for the same time period. There shall be no more than 1 percent sensor misses in any one lane for the same time period.

REVISION OF SECTION 614
EQUIPMENT PROCUREMENT AND CONFIGURATION

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

To ensure that the Colorado Transportation Management Center (CTMC) personnel have sufficient time for the final configuration of the Ethernet switches on this project, the Contractor shall submit all network equipment cut sheets to the Project Engineer at the Pre-Construction Meeting. This submittal shall include but not be limited to the follow project network equipment;

- Ethernet Switches
- Coarse Wavelength Division Multiplexing, Small Form-Factor Pluggable Optic Modules
- 1310 NM Small Form-Factor Pluggable Optic Modules
- All Licensing And Warranty Documentation
- All Materials Associated With The Installation Of The Ethernet Switches

After the review and approval of the networking equipment cut sheets by the Project Engineer, the Contractor shall place the order for the approved equipment to the CenturyLink representative listed in the project specifications to ensure the early delivery of the above listed items. The CenturyLink representative is:

Keith A. Glose
Premier Account Manager
CenturyLink Government
930 15th Street, 4th Floor, Denver, Colorado 80202
Telephone: 303-992-5567 Fax: 720-578-2694
E-Mail: keith.glose@centurylink.com

The network equipment as part of this project requires both CTMC personnel and Ciena technical network representatives to jointly configure each individual Ethernet switch in addition to the configuration of these switches into the CTMC statewide intelligent transportation network.

The Contractor shall coordinate with the Project Engineer to schedule the Ciena technical representative and the CTMC personnel for a window of time that the configuration may occur. The Contractor shall deliver the Ethernet switches and associated equipment for the switch configuration to CTMC personnel a minimum of three weeks in advance of field installation to allow for CDOT to configure the switches. All costs associated with the Ciena technical representative assistance shall not be paid for separately but will be included in Item 614 – Ethernet Switch.

REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

Test Fiber Optic Cable shall include Optical Time Domain Reflectometer (OTDR) tests, Coarse Wave Division Multiplexor (CWDM) OTDR tests, spectrum analysis of CWDM fiber, and optical power meter tests of all installed fiber and modified existing fiber on the project.

MATERIALS

The Contractor shall use equipment that is calibrated biennially. A copy of the most recent certificate of calibration and all out-of-tolerance conditions shall be provided to the Project Engineer prior to the initiation of testing activities. The following equipment and information is required to perform fiber optic cable tests:

(1) an OTDR (submit certification to Project Engineer)

(2) A Coarse Wave Division Multiplexor OTDR (submit certification to Project Engineer)

(3) An optical spectrum analyzer (submit certification to Project Engineer)

(4) Optical Power Meter Equipment capable of measuring optical power in dBm (submit certification to Project Engineer)

(5) a launch box (min length – 1000 feet)

(6) a light source at the appropriate wavelength

(7) Test jumpers shall be 3 feet to 12 feet long with connectors that are compatible with the light source and power meter and shall have the same fiber construction as the link segment being tested.

CONSTRUCTION REQUIREMENTS

Prior to splicing and testing on the project the Contractor shall submit a detailed Method Statement to the Project Engineer describing the splicing plan and testing schedule and methods. No fiber optic splicing shall begin until the Method Statement is submitted and approved. Once the splicing and testing begins, the Method Statement shall be updated if necessary to address any required changes in the original planned and approved procedures.

The contractor shall conduct fiber optic testing at the following stages:

(1) Pre-installation testing – bi-directional OTDR test of every fiber on every reel after delivery of the reel
(2) Post installation and pre-splicing test – bi-directional OTDR test of every fiber of every cable after fiber is installed in the ground
(3) Post-splicing tests, pre-CWDM filter splicing tests
    i) Optical Power meter test from all fiber terminated in communications cabinets to a network facility for all fiber that is not used for CWDM on the project.
    ii) Bi-directional OTDR test of all fiber between termination point in a network facility and cable end and between termination point in a network facility and communications cabinets for fiber that is not used for CWDM on the project

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REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

iii) Bi-directional CWDM OTDR test of all fiber between termination point in a network facility and cable end and between termination point in a network facility and communications cabinets for all fiber that is used for CWDM on the project

(4) Post-CWDM filter splicing tests
   i) Spectrum analysis of all terminated fiber used for CWDM after filters have been spliced
   ii) CWDM-OTDR
   iii) Optical Power meter test

(5) Re-testing of all stages above if initial test fails and after corrective action is taken

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: Single mode fiber 9.0μm (nominal) /125 μm
(2) The light source and OTDR must operate within the range of 1310±10 nm and 1550±20 nm single mode nominal wavelength for testing in accordance with Telecommunications Industry Association (TIA) TIA-526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
(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.
(5) The calibration of the OTDR and power meter shall conform to the requirements set forth in Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA) TIA/EIA-455-226 Calibration of Optical Time-Domain Reflectometers and TIA-455-231 Calibration of Fiber Optic Power Meters, respectively.

The contractor shall document jacket length measurements for lateral and backbone cable at each end including splice enclosures and patch panels.

The Contractor shall document bare fiber slack not accounted for in jacket length.

All system connectors, adapters and jumpers shall be cleaned per manufacturer's instructions before measurements are taken.

At locations of new lateral fiber optic cable installation and at locations that require the re-installation of existing lateral fiber optic cable, the Contractor shall conduct testing from the termination panel mounted in the communications cabinet to the splicing manhole. The bi-directional test shall be conducted from the termination panel towards the splicing manhole and from the splicing manhole to the communications cabinet termination panel.

Final splicing will not begin until such time that the Contractor submits OTDR test results to the Project Engineer and the Project Engineer reviews the results.

Final OTDR testing from the communications cabinet to the corresponding traffic management system building shall be conducted after their splicing work has been completed. All issues with communications related to Contractor installation and workmanship shall be remediated by the Contractor at no additional cost to the project.

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REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

A functional test shall be made in which it is shown that each and every part of the system functions as specified or intended herein.

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 Project 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.

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.

The Contractor shall use a test reel of minimum length identified in the Materials section of this Special Provision. The Contractor shall indicate the length of the test reel, in feet, 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.

The Contractor shall record the following information during the test procedure:

(1) Name and contact information of person 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) Optical source wavelength and spectral width
(5) Fiber identification
(6) Start and end point locations
(7) Test direction
(8) Launch conditions
(9) Method of calculation for the attenuation or attenuation coefficient
(10) Acceptable link attenuation
(11) Cable manufacturer stated index of refraction for cable being tested
(12) Jacket readings in and out of each splice vault and each pull box

Optical Fiber Cable Testing with Optical Power Meter

The Contractor shall conduct an Optical Power Meter Test of each fiber installed.

Single mode segments shall be tested in one direction at both the 1310 nm and 1550 nm wavelength.

The following information shall be recorded during the test procedure:

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REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

(1) Names of personnel conducting the test
(2) Type of test equipment used (manufacturer, model, serial number, calibration date and a valid certification of calibration)
(3) Date test is being performed
(4) Optical source wavelength and 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

Acceptable Attenuation Values

The Contractor shall calculate acceptable attenuation values for each fiber tested. These values represent the maximum acceptable test values.

The general attenuation equation for all single mode link segments is as follows:

Acceptable Link Attenuation = Cable Attenuation + Connector Attenuation + Splice Attenuation.

8.3 μm (nominal) Single-mode Attenuation Coefficients:

(1) Cable Attenuation=Cable Length (km) x (0.35 dB/km at1310 nm and 0.22 dB/km at1550 nm)
(2) (No. of Mated Connections x 0.50 dB)
(3) Splice Attenuation = Splices x 0.30 dB

Test Procedures

The single mode Optical Power Meter fiber test shall be conducted in accordance with TIA-526-7.

The single mode OTDR test shall be conducted in accordance with TIA-526-7.

Testing for CWDM single wavelength filters (CWDM filter) shall be conducted in the following manner to ensure that the filter Pass, Reflect and Common pigtails are spliced to proper lateral fiber strands. Testing procedures and CWDM data flow information is included on the plans. Testing shall be conducted for all CWDM wavelengths applicable to each fiber strand used for data communications. CWDM wavelengths on this project include 1430 nm, 1450 nm, 1470 nm, 1490 nm, 1510 nm, 1530 nm, 1570 nm, 1590 nm, and 1610 nm. Industry standard wavelengths (e.g. 1430 nm = 1431 nm) shall be observed.

After completion of fiber optic cable installation and prior to the CWDM filter splicing, all backbone cable to lateral cable splices shall be completed in the individual Ethernet switch sub-rings. Required steps shall include:

(1) The backbone end of Lateral Cable 1 shall be spliced to the fiber optic backbone cable in Splice Closure 1. Once this splice is complete no future access to Splice Closure 1 shall be made unless a re-splice is required.

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REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

(2) The opposite end of Lateral Cable 1 shall be spliced to itself in Splice Closure 2 in a manner to achieve continuity in the backbone strands from the beginning of the sub-ring (first traffic management system building) to the far end of the sub-ring (next traffic management system building).
(3) An OTDR test shall be conducted on the sub-ring from building to building to ensure proper splicing of Lateral Cable 1 in Splice Closure 1.

Once the OTDR test is complete the results shall be submitted to the Project Engineer for approval. After approval the splicing of CWDM filters in Splice Closure 2 may begin.

The Contractor shall be required to break the Lateral Cable 1 splices in Splice Closure 2 used in the continuity test and conduct the CWDM filter splicing per the project fiber splice plans. This will include splicing of Lateral Cable 1 and Lateral Cable 2 in Splice Closure 2 and the termination of Lateral Cable 2 in the communications cabinet.

After CWDM filter splicing, the Contractor may use one of the following methods to ensure the proper CWDM filter splicing.

(1) By using a fiber identifier, testing of the incoming signal from either the upstream or downstream CWDM location, the Contractor shall show the Project Engineer that proper CWDM filter pigtail splicing has been achieved.
(2) By using a spectrum analyzer to test the incoming wavelength to ensure proper splicing and wavelength of the CWDM signal.

Once all splicing of the individual sub-ring is complete the Contractor shall conduct the CWDM-OTDR and spectrum analyzer testing and submit the results to the Project Engineer. At the acceptance of these tests, the Contractor shall determine the proper optical attenuator to install at both the communications termination panel and the communications node building termination panel. After installation one final test of optical power shall be conducted to determine if the proper signal strength is being achieved by the Ethernet switch CWDM optic.

At that point the Colorado Department of Transportation, Colorado Transportation Management Center personnel along with Ciena network engineers will configure the sub-ring into the overall CDOT ITS network. If network communications cannot be achieved, a review of the CWDM testing materials will be begin.

Test Acceptance

The Contractor shall demonstrate that the tests result in acceptable attenuation values.

The Contractor, solely at the Contractor's expense, shall re-splice all fusion splices and re-terminate all terminations that have test results exceeding acceptable attenuation values. The Contractor, solely at the Contractor's expense, shall retest all fiber links that have been re-spliced and shall retest all fiber links that have been re-terminated.

The Contractor, solely at the Contractor's expense, shall bring all links not meeting the requirements of this specification into compliance.

Submittals

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REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

The Contractor shall submit test result 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 two hard copies and one electronic copy of the following tests:

(1) Continuity OTDR trace for every spliced fiber which the CWDM optical network will utilize.
(2) OTDR trace for every fiber the high speed DWDM optical network will utilize.
(3) CWDM-OTDR trace for every fiber which the CWDM optical network will utilize.
(4) Spectrum analyzer test results for every fiber which the CWDM optical network will utilize.
(5) OTDR traces and power meter results for all "dark" unused fiber strands in the backbone fiber optic cable from traffic management system buildings.

Hard copy traces shall be organized and bound in logical order in an 8 ½ inch x 11 inch 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 all change orders, with all deviations clearly marked in color. Deviations to be noted shall include at a minimum, but not be limited to, the following:

(1) Fiber Splice location
(2) Fiber Splice configuration
(3) Termination layout

METHOD OF MEASUREMENT

Testing of fiber optic cable will be measured by all fiber optic testing, retesting, including all labor, materials, and document submittals necessary 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 backbone and lateral single mode fiber optic cables as indicated on the project plans.

MATERIALS

All fiber optic cables shall be suitable for outdoor conduit installation.

All fiber optic cable shall have compatible characteristics with other proposed and existing fiber optic cables.All optical cables furnished on this project shall meet the following fiber optic industry standards:

(1) International Telecommunications Union – Telecommunications Standardization Sector - Recommendation G.652.D
(2) Telecommunications Industry Association (TIA) - 598-D Optical Fiber Cable Color Coding
(3) International Organization for Standardization (ISO) - 9001
(4) Rural Utilities Service (RUS)- Specification for filled fiber optic cables

All cables shall be new and unused non-armored outdoor cable consisting of non-dispersion shifted, low water peak single-mode fiber strands free of surface imperfections and inclusions. Each single mode fiber strand shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be of matched clad design.

Fiber Strands

Fiber strands shall meet the following minimum characteristics:

(1) Typical core diameter of 9.0µm ± 1 µm
(2) Cladding Diameter of 125 µm ± 1 µm
(3) Core concentricity error: ≤ 0.6 µm
(4) Cladding Noncircularity: ≤ 1.0 %
(5) Coating Diameter (Colored): 245 ± 5 µm
(6) Maximum Attenuation (Loose Tube): 0.35 dB//km at 1310 nm wavelength and 0.22 dB/km at 1550 nm wavelength
(7) Mode-Field Diameter: 9.20 ± 0.30 µm at 1310 nm wavelength and 10.40 ± 0.50 µm at 1550 nm wavelength
(8) Attenuation at the Water Peak: 0.32 to 0.34 dB/km at 1383 ± 3 nm wavelength
(9) Cutoff Wavelength: ≤1260 nm
(10) Zero Dispersion Wavelength: 1300 nm to 1324 nm
(11) Zero Dispersion Slope: ≤ 0.092 ps / (nm^2 * km)
(12) Polarization Mode Dispersion: ≤ 0.06 ps/ $\sqrt{}_{km}$
(13) Maximum Polarization Mode Dispersion at 0.01% distribution (PMDq): 0.20 ps/$\sqrt{}_{km}$
(14) Maximum Fiber Dispersion: ≤ 18 ps/(nm*km) at 1550 nm.
(15) Fiber Curl: ≥ 4.0 m
(16) Proof Tensile Test: 100 kpsi (0.69 GN/m^2)

The fibers shall not adhere to the inside of the buffer tube.

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REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)

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 to 2.0 lbf.

Each single mode fiber strand shall be color coded with distinct and recognizable colors in accordance with the TIA-598-D *Optical Fiber Cable Color Coding*.

Buffer Tubes

Each backbone buffer tube shall contain 12 fiber strands and each lateral fiber cable shall have two buffer tubes with six fiber strands in each.

Optical fibers shall be placed inside a loose buffer tube.

Each buffer tube shall be color coded with distinct and recognizable colors in accordance with TIA-598-D

If fillers are required, they shall be placed in the inner layer of the fiber optic cable. The color sequences of the buffer tubes shall begin from the inside layer of and progress outward.

Buffer tube black stripe shall be inlaid in the buffer tube material by means of co-extrusion when required.

In buffer tubes containing multiple fibers, the coloring shall be stable during temperature cycling and shall not be subjected to fading or smearing onto each other or into the buffer tube gel filling material if the fiber cable is supplied with gel filling for water blocking. Colorings shall not cause fibers to stick together.

Each buffer tube shall contain water blocking swellable yarns to prevent water from entering the individual buffer tubes. Swellable water blocking material shall be non-nutritive to fungus, electrically non-conductive and homogeneous. It shall be free from dirt and foreign matter and not require cleaning prior to splicing and placement into the splice closure tray. All fiber strands shall be thoroughly cleaned prior to fiber splicing. All water blocking material shall be uniformly distributed throughout the buffer tubes.

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 shrinkback requirements of Code of Federal Regulations (CFR) 7 CFR 1755.900 – *RUS Specification for filled fiber optic cables*.

Fiber Cable

Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed and shall not be placed to interrupt the consecutive positioning of the buffer tubes. Fillers shall nominally match the outer diameter of fiber filled buffer tubes.

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REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)

The central anti-buckling member of the cable shall consist of all dielectric, glass reinforced plastic (GRP) rod.

For single layer cables, a water swellable, (blocking) tape shall be applied longitudinally around the outside of the buffer tubes and fillers. The tape shall be held in place by a single polyester binder yarn. The water swellable tape shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter. Water blocking material shall be applied uniformly throughout the fiber cable to inhibit the ingress of water into the cable. Gel filled water-blocking compound shall not be allowed in the cable core interstices of the fiber optic cables.

When the fiber cable is provided with dual layer buffer tubes, both the inner and outer layer shall be provided with water swellable tape.

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.

Outer cable jacket shall have a consistent thickness throughout the entire cable length and shall be sheathed with medium density polyethylene (MDPE). Jacketing material shall be applied directly over the tensile strength members and water blocking tape. The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class , Category 4 and Grades J4, E7 and E8 and 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 and be of a consistent thickness.

Cable jackets shall be marked with the manufacturer's name, sequential foot markings, fiber type and count, month and 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 percent of the length markings. The marking shall be in contrasting color to the cable jacket. The height of the marking shall be a minimum of easily readable.

The Contractor shall submit to the Project Engineer a detailed fiber optic cable specification sheet from the manufacturer for approval. The specification sheet shall be highlighted describing the water blocking material used for both the cable interstices and buffer tubes. Failure to fully describe the type of water blocking material shall result in the submittal being rejected and resubmitted with all highlighted information.

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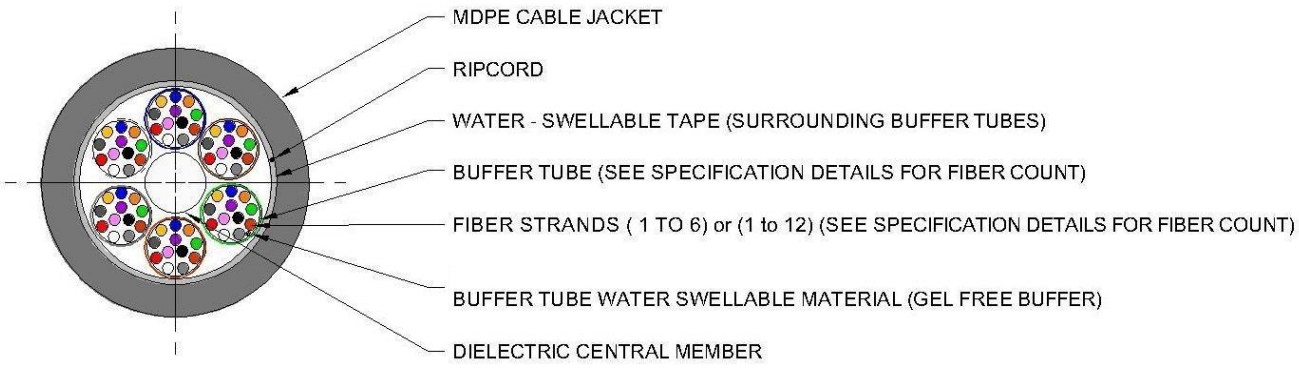
REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)



Specification Detail 1
Typical Cross Section of Fiber Optic Cable to Be Provided Per This Specification

Environmental Parameters

The following minimum environmental parameters shall be met:

(1) Shipping, storage and operating temperature range of the cable shall be; -40°F to +158°F (-40°C to +70°C)
(2) Operating temperature range of the cable shall be; -40°F to 158°F (-40°C to +70°C)
(3) Installation temperature range of the cable shall be; -22°F to +140°F (-30°C to +60°C)

Quality Assurance

The following minimum quality assurance requirements shall be met:

(1) All optical fibers shall be 100 percent attenuation tested in accordance with Revision of Section 614 – Test Fiber Optic Cable. The attenuation of each fiber shall be provided with each cable reel.
(2) The cable manufacturer shall be ISO 9001or TL 9000 registered.

Packaging

The following minimum packaging parameters shall be met:

(1) The complete cable shall be packaged for shipment on non-returnable wooden reels.
(2) Top and bottom ends of the cable shall be available for testing.
(3) Both ends of the cable shall be sealed to prevent the ingress of moisture.
(4) Each reel shall have a weatherproof reel tag attached identifying the reel and cable.
(5) Each cable shall be accompanied by a cable data sheet that contains significant information on the cable.
(6) The cable reels shall not be stored nor shipped on their sides.

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REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)

CONSTRUCTION REQUIREMENTS

Fiber optic cable shall be used for either main backbone cable or lateral cables that connect to communications cabinets. The main backbone cable shall be terminated in a traffic management system building or network facility. Splicing shall be conducted at cable end splice locations and device splice locations shown on the project plans or as approved by the Project Engineer.

A minimum of one week prior to fiber optic work, the Contractor shall give the Project Engineer a detailed installation and splicing Method Statement and schedule. All installation, splicing, termination, and testing shall be listed on the schedule and Method Statement and revisions shall be re-submitted to the Project Engineer immediately. Installation of the fiber optic cable shall not be permitted until the Method Statement and schedule has been approved by the Engineer.

The Contractor shall be responsible for coordinating with third parties when installing and splicing proposed fiber optic cable adjacent to existing third party owned fiber optic infrastructure and when splicing proposed fiber optic cable to existing third party owned fiber optic cable. The Contractor shall keep the Project Engineer apprised of all coordination activities it performs with third parties as it pertains to this project.

The Contractor shall conform to the requirements included in Test Fiber Optic Cable.

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.

Fiber optic cable including both backbone cables and lateral cables shall be installed in continuous runs as shown on the project plans. If cable end splices are not shown on the project plans, the Contractor shall include a detailed installation plan with the Method Statement showing cable installation lengths and cable end splice points. The fiber cable shall be installed in reel lengths that minimize the quantity of cable end splices. Under no conditions shall fiber optic cable be cut or spliced at intermediate points without express written direction from the Engineer.

The new fiber cable shall be installed in a manner which will not interfere with the integrity of existing cable and equipment and shall be installed in a manner which will not interfere with the maintenance of the traffic signal cable, wiring or equipment.

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 600 pounds (2700 N) during installation (short term) and 200 pounds (890 N) long term installed.

All cables shall have a minimum bending radius based on the diameter of the cable and shall meet the following;

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REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)

(1) Under max pulling tension – 15 (Fifteen times the cable outside diameter)
(2) Unloaded, not under tension – 10 (Ten times the cable outside diameter)

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 maximum allowable pull tension 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 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 and 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.

The Contractor shall furnish and install a pre-lubricated pull tape and tracer wire in the same conduit as the fiber is being installed. The pull tape and tracer wire shall conform with and be paid for under Revision of Section 613 – Electrical Conduit.

If the Contractor must install new cable in conduits that contain existing fiber optic cable or electrical wiring, the Contractor shall be responsible for all damage to the existing cables and wires. After this installation the Contractor shall perform a functional test of all the equipment connected by the existing fiber cables and electrical wiring to ensure proper working conditions. All costs associated with equipment testing and repairs shall be included in the cost of the fiber optic cable.

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 conduit fill ratio of new conduit exceed the requirements of the National Electrical Code.

Lateral cables shall be installed in continuous runs from the backbone splice location to the communications 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.

Installation of lateral fiber optic cables shall include slack coil and a minimum of three strain relief locations within all communications cabinets and traffic signal cabinets.

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REVISION OF SECTION 614
FIBER OPTIC CABLE (SINGLE MODE)

All fiber optic cables shall include identification labels attached to the cable in each pull box, manhole or communications cabinet. The label shall be provided with information as shown on the Plans.

The Contractor shall coil 50 feet of each fiber cable in pull boxes and 100 feet in manholes.

The Contractor shall ensure that all cable coils and splice canisters are attached separately to the cable management hardware inside manholes in a manner which will allow for all splice closures to be removed separately for future maintenance purposes. In Pull Boxes, all cable coils shall be attached separately to the cable management hardware in a manner which will allow for fiber optic cable to be removed separately.

The Contractor shall terminate the lateral cable at the communications cabinet in accordance with the Revision of Section 614 – Fiber Optic Termination Panel.

Prior to performing splicing and testing for CDOT traffic signals, the Contractor shall CDOT Transportation System Management and Operations (TSM&O) branch at 303-512-5801 to allow for traffic signal technicians to disconnect all existing optical communications equipment.

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 splice closures and all associated materials
(2) All splicing at designated locations shown in the plans or as directed by the Project Engineer
(3) Identification labels for both backbone and lateral fiber cables in each pull box, manhole, communications cabinet and network facility
(4) As Built Documentation

Testing Fiber Optic Cable shall be measured and paid for separately. See Revision of Section 614 - Test Fiber Optic Cable project special provision.

REVISION OF SECTION 614
FIBER OPTIC CABLE INSTALLATION

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

Fiber optic cable installed on this project will be installed in electrical conduits, pull boxes and equipment communication cabinets which contain existing electrical cable or electronic equipment currently carrying communications data from existing intersection traffic signals or ITS roadway devices. The new fiber cable shall be installed in a manner which will not interfere with the integrity of the existing cable and or equipment. Slack fiber cable shall be coiled in pull boxes, manholes and communications cabinets using proper fiber management as noted on the plans. Fiber optic cable installed in traffic controller and ITS cabinets shall be placed in a manner which will not interfere with the maintenance or the traffic signal cable, wiring or equipment. All OTDR testing shall be conducted as stated in this specification and in accordance with the Project Special Provision, Test Fiber Optic Cable, included in this plan set. If OTDR test results show that the backbone or lateral cables have been damaged, the entire backbone or lateral cable must be replaced from cable end splice point to cable end splice point at no additional charge to the project.

The Contractor shall install all fiber optic cables in accordance with the splicing diagrams as shown in the plans. The Contractor shall conduct an on-reel test prior to installing any fiber cables. After the on-reel test the Contractor shall provide the Project Engineer with all resultant documentation prior to actual cable installation. No installation shall commence until the Project Engineer reviews and accepts all test results showing all fibers in the cables are undamaged, containing no breaks or micro bends. Once the results are accepted, the fiber cable may be installed. If the test results show damage to any strand or strands within a reel, that reel shall be rejected, replaced and retested at no additional cost to the project.

Once the fiber cable is accepted by the Project Engineer, the cable may be installed. The fiber cable is to be installed in reel lengths that minimize cable end splices, in turn minimizing fiber cable loss. Once the entire cable is installed and all cable end splices are complete, bi-directional testing shall be conducted to assure that no damage occurred in the installation process.

For backbone fiber cable, if any strand(s) of the fiber cables show damage from the Contractor's installation, that entire end-to-end (reel-to-reel) section of fiber cable shall be removed, re-installed and re-spliced from the cable end splice point at no additional cost to the project.

For lateral fiber cable, if any strand(s) of the fiber cables show damage from the Contractor's installation, the entire end-to-end (reel-to-reel) section of fiber cable shall be removed, re-installed and re-spliced from the splice point to the device communication cabinet at no additional cost to the project.

Prior to any fiber optic work, the Contractor shall give the Project Engineer a detailed installation and splicing schedule a minimum of one week, prior to commencing work. All installation, splicing, termination, and testing shall be listed on the schedule and any revisions to this schedule shall be re-submitted to the Project Engineer as soon as the changes are made.

After completing all splicing and termination work, a final inspection of the fiber network will be conducted. If damage exists to the fiber optic cable system due to Contractor negligence, all costs associated with the cable, pulling of the cable, splicing, splice canisters and testing of the network shall be at the Contractor's expense.

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REVISION OF SECTION 614
FIBER OPTIC CABLE INSTALLATION

Prior to performing splicing and testing for the CDOT traffic signals, Contractor shall notify Jeff Lancaster with CDOT Region 1 Traffic at 303-757-9511 to allow for the Region 1 traffic signal technicians to disconnect the existing optical transceivers. If the Contractor splices or tests the fiber while the traffic signals optical transceivers are connected then the traffic signals will go into flash mode

REVISION OF SECTION 614
ETHERNET SWITCH

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

For this project, the CDOT Ethernet Switches shall be either Ciena Model 3930 or 3931 Carrier Grade Ethernet Field Delivery Switch (Pay Item – Ethernet Switch) as noted on the plans and shall be furnished and installed at roadway Intelligent Transportation System (ITS) devices for data communications from the field device to the regeneration node. At Node 2 and at the northern end of the project near the 120th Avenue interchange, Ciena 5150 Aggregation Switches (Pay Item – Ethernet Router) shall be furnished and installed. Ciena Model 3931 units come housed in a weatherproof enclosure and can be mounted directly to a pole. This weatherproof enclosure and related components, including mounting hardware, are paid for as part of the Ethernet Switch pay item.

MATERIALS

This Ethernet field delivery switch is proposed for the transport of Ethernet data for roadway devices on this project from the device cabinet locations to the proposed aggregation Ethernet switches installed in the communications node building (Node 2) and in a proposed field cabinet located at the northern end of the project near the 120th Avenue interchange.

Each field delivery switch shall be equipped with two redundant, hot swappable power supplies that are accessible from the front of the chassis. Each AC power supply shall be rated for 100 to 240 VAC, 50/60 Hz, and 1.0 to 0.5 A. The combining of one AC and one DC power supply in the same switch chassis shall not be permitted. One power cord shall be included with each AC power supply used in the field delivery switch chassis. The power cords shall be of sufficient length and wire gauge for the voltage and load of each switch. For the Ciena 3931, one power cord retaining clip shall be included for each power supply since the power supplies will be installed in a vertical configuration with the input side facing downward.

Each Ciena 3930 field delivery switch shall be configured with the following Ethernet ports: four (4) 100/1000 Mbps Small Form-Factor Pluggable (SFP) ports; four (4) 10/100/1000 Mbps RJ-45/SFP combination ports; and two (2) 1/10 Gbps SFP+ Ethernet ports. Four (4) 10/100/1000 Mbps SFP transceiver with RJ-45 connector shall be provided for each Ciena 3930 field delivery switch to increase the availability of copper ports from four (4) to eight (8).

Each Ciena 3931 field delivery switch shall be configured with the following Ethernet ports: four (4) 100/1000 Mbps SFP ports; four (4) 10/100/1000 Mbps RJ-45 ports; and two (2) 1/10 Gbps SFP ports.

Each field delivery switch shall be configured with one of the options listed below as shown in the Plans.

Two (2) 100/1000 Mbps SM CWDM SFP optic modules;

One (1) 100/1000 Mbps SM CWDM SFP optic module and one (1) 100/1000 Mbps SM 1310 nm SFP optic module; or

Two (2) 100/1000 Mbps SM 1310 nm SFP optic modules.

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REVISION OF SECTION 614
ETHERNET SWITCH

The 100/1000 Mbps SM CWDM SFP optic modules shall be available in wavelengths ranging from 1430 nm to 1610 nm in 20 nm increments. All SFP optic modules provided shall be sufficient for the distance and attenuation associated with each cable segment's unique link loss budget. All components and SFP optic modules shall be the type and manufacturer approved by Ciena.

Permanently installed fixed or variable optical attenuators shall also be provided by the Contractor, as required, to reduce the transmitter power from being too intense for the receiver sensitivity of the SFP optic modules being utilized for each link once the actual optical path loss is known. The optical attenuators shall provide a system performance margin of not less than 6 dB.

Ciena 3930 units shall include the switch, power supplies, power cords, rack mount ears, SFP modules (electrical and optical), warranties, licenses, Optical Add/Drop Modules (OADM), and optical attenuators.

Ciena 3931 units shall include the switch, weatherproof enclosure, power supplies, power cords, pole mount kits, cable entry seals, SFP modules (optical), warranties, licenses, OADM, optical attenuators, and battery backup unit.

All applicable licenses and warranties, with the terms indicated in the item table, shall be provided with each Ethernet switch proposed as part of this project.

The CDOT CenturyLink project equipment estimate quotations and purchasing distributer representative for Ciena is:

Keith A. Glose
Premier Account Manager
CenturyLink Government
930 15th Street, 4th Floor, Denver, Colorado 80202
Telephone: 303-992-5567 Fax: 720-578-2694
E-Mail: keith.glose@centurylink.com

The Contractor shall coordinate with Ciena to verify that the item table provided is complete in order to provide a wholly-functioning communications system. All items not specifically mentioned herein or in the item table below, shall be considered as included in the contract unit price per switch. The Contractor shall furnish and install the Ethernet Switch as configured in the item table below, as shown in the Plans, as required in the specifications, and as recommended through its coordination with Ciena. The table describes items for a single Ciena Carrier Grade Ethernet field delivery switch; quantities shall be as indicated and as necessary to provide a wholly functional Ethernet Switch.

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REVISION OF SECTION 614
ETHERNET SWITCH

Ciena Carrier Grade Ethernet Switch (Field Delivery Switch)

Item Description	Item Number
Ciena 3930, four 100/1000 Mbps SFP ports, four 100/1000 Mbps RJ-45/SFP combo ports, two 1/10 Gbps SFP+ ports, extended temperature, two slots for AC power supplies	170-3930-900
Ciena 3930, AC pluggable power supply, wide range 120/240 VAC	170-0014-900
Ciena 3930, AC power cord, IEC C13, North America	CABL-PW01NA
Ciena 3930, 19" rack mount ears, for use with 1 RU chassis	170-0602-903
Ciena 3930, 10/100/1000 Mbps, SFP transceiver, RJ-45 connector, Serial Gigabit Media Independent Interface (SGMII), 100 m, extended temperature	XCVR-A00CRJ
Ciena 3930, SmartSupport, 3 year (one per switch)	80M-3930-SM3
Ciena 3930, 10-day Repair & Replace (R&R) extended hardware maintenance, 2 year (one per switch)	80M-3930-HW2
Ciena 3930, next business day advance replacement, 3 year (one per switch)	80M-3930-NA3
Ciena 3931, weatherproof enclosure, one slot for pluggable system module, two slots for AC pluggable power supplies	120-3931-900
Ciena 3931, pluggable system module, four 100/1000 Mbps SFP ports, four 10/100/1000 Mbps RJ-45 ports, two 1/10 Gbps SFP+ ports	170-3931-900
Ciena 3931, AC pluggable power supply, wide range 120/240 VAC	170-0042-900
Ciena 3931, AC power cord, IEC C15, 10 ft, outdoor, North America	170-0019-902
Ciena 3931, UAM, pole mount kit	MISC-MKPM01
Ciena 3931, three band clamps for use with UAM pole mount kit	MISC-BCPM01
Ciena 3931, cable entry seal, OSP fiber, ½"	170-0074-900
Ciena 3931, SmartSupport, 3 year (one per switch)	80M-3931-SM3
Ciena 3931, 10-day Repair & Replace (R&R) extended hardware maintenance, 2 year (one per switch)	80M-3931-HW2
Ciena 3931, next business day advance replacement, 3 year (one per switch)	80M-3931-NA3
Ciena 3930/3931, 100/1000 Mbps, SM SFP optic, LC connector, 80 km, 1xx0 nm, extended temperature (xx = 43 through 61), as indicated on plans.	XCVR-A80Dxx
Ciena 3930/3931, 100/1000 Mbps, SM SFP optic, LC connector, 10 km, 1310 nm, extended temperature	XCVR-A10Y31
Ciena 3930/3931, 1-lamda, 3-port field deployable add/drop, SMF-28 pigtails, 1xx0 nm (xx = 43 through 61), as indicated on plans.	CWDM-3ADMxx
Ciena 3930/3931, Service Aware Operating System (SAOS) advanced Ethernet perpetual software license (one license per switch)	S70-0001-900

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REVISION OF SECTION 614
ETHERNET SWITCH

Item Description	Item Number
Ciena 3930/3931, SAOS advanced Operations, Administration, and Maintenance (OAM) perpetual software license (one license per switch)	S70-0001-901
Ciena 3930/3931, SAOS advanced security perpetual software license for use with SAOS 6.X (one license per switch)	170-0204-900
Ciena 3930/3931, Ethernet Services Manager (ESM) carrier Equipment Degrade (ED) right to manage perpetual software license (one license per switch)	S70-0005-900

This Ethernet switch is proposed as an aggregation switch for the transport of Ethernet data for roadway devices on this project. Connections to the switch shall be both to the proposed roadside Ethernet field delivery switches and to the proposed core Ethernet backbone switch installed in Node 2. The switch shall be configured with the ability to accept up to thirty three (33) 1 Gbps SFP CWDM optic modules in addition to two (2) 10 Gigabit Small Form Factor Pluggable (XFP) based Ethernet ports. The switch will have a maximum capacity of forty eight (48) 1 Gbps ports and four (4) 10 Gbps ports. All components shall be manufactured by Ciena.

All optic modules, (CWDM, 1310 nm, and 1550nm) shall be the type, manufacturer, and quantity as required by Ciena and as needed to make a wholly-functioning communications system.

All applicable licenses and warranties shall be provided with each Ethernet switch proposed as part of the ITS network. The Contractor shall furnish and install the Aggregation Ethernet Switch as configured in the item table below. The table describes items for a single Ciena Carrier Grade Ethernet Aggregation switch

Ciena Carrier Grade Ethernet Switch (Aggregation)

Item Description	Item Number
Ciena 5150, (48) 100/1000 Mbps SFP, (2) slots 10G dual XFP module, extended temperature, (2) slots AC plug power supply	170-5150-900
Ciena 5150, AC pluggable power supply, 120/240 VAC (two power supplies per switch)	170-0100-902
Ciena 5150, AC power cord, IEC C13, North America (two power cords per switch)	CABL- PW01NA
Ciena 5150, (2) 10 Gig XFP module	170-5101-900
12-slot LGX mounting panel w/integrated fiber management, 4RU (provide at Node 2, as required, to accommodate 10-lambda CWDM mux/demux modules utilized on this project)	CWDM- PAN012
10-lambda CWDM mux/demux with expansion port, 2-slot LGX rack module, LC/APC connectors (one module at Node 2 per pair of fiber strands utilized to interconnect Ciena 3930 and 3931 field delivery switches to the Ciena 5150)	CWDM-EMUX10
10-lambda field deployable CWDM mux, SMF-28 pigtails (one module at Model 336 cabinet [sta 362+45] per pair of fiber strands utilized to interconnect Ciena 3930 and 3931 field delivery switches to the Ciena 5150)	CWDM-0MUX10

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REVISION OF SECTION 614
ETHERNET SWITCH

Item Description	Item Number
10-lambda field deployable CWDM demux, SMF-28 pigtails (one module at Model 336 cabinet [sta 362+45] per pair of fiber strands utilized to interconnect Ciena 3930 and 3931 field delivery switches to the Ciena 5150)	CWDM-DMUX10
100/1000 Mbps, SM SFP optic, LC connector, 80 km, 1**xx**0 nm, extended temperature (**xx** = 43 through 61) (as required based on network diagrams), as indicated on plans.	XCVR-A80D**xx**
10 Gig, MM XFP, LC connector, 300 m, 850 nm, extended temperature (as required for Ciena 5150 at Node 2)	XCVR-A00Z85
10 Gig, SM XFP, LC connector, 40 km, 1550 nm, extended temperature (as required for Ciena 5150 at Node 2 and Model 336 cabinet)	XCVR-A40V55
SAOS advanced Ethernet perpetual software license for 48-port Ciena 5150 chassis (one license per switch)	170-0205-904
SAOS advanced OAM perpetual software license for 48-port on Ciena 5150 chassis (one license per switch)	170-0206-904
SAOS advanced Ethernet perpetual software license for Ciena 5150 (2) 10 Gig module (one license per switch)	170-0205-905
SAOS advanced OAM perpetual software license for Ciena 5150 (2) 10 Gig module (one license per switch)	170-0206-905
SAOS advanced security perpetual software license for use with SAOS 6.X (one license per switch)	170-0204-900
ESM carrier ED right to manage perpetual software license 48-port Ciena 5150 chassis (one license per switch)	170-0301-904
ESM carrier ED right to manage perpetual software license for Ciena 5150 (2) 10 Gig module (one license per switch)	170-0301-905
SmartSupport, Ciena 5150, per chassis, 3 year (one per switch)	80M-5150-SM3
SmartSupport, Ciena 5150, per line module, 3 year (one per switch)	80M-515L-SM3
Hardware warranty, Ciena 5150, per chassis, 2 year (one per switch)	80M-5150-HW2
Next business day advance replacement, Ciena 5150, per chassis, 3 year (one per switch)	80M-5150-NA3
Hardware warranty, Ciena 5150, per line module, 2 year (one per switch)	80M-515L-HW2
Next business day advance replacement, Ciena 5150, per line module, 3 year	80M-515L-NA3

The Contractor shall provide bend insensitive (glass per ITU-T G.657.A standard) tactical fiber optic patch cables with polyurethane jackets for the connection of all roadside field delivery Ethernet switches, all aggregation Ethernet switches and all backbone Ethernet switches. These cables shall be used both from each Ethernet switch optic module to the associated fiber optic patch panel and from each Ethernet switch to Ethernet switch connections, (switch optic module to switch optic module. The cable shall be a single mode-duplex cable, in lengths sufficient to span from the switch to the patch panel with a minimum of 2 feet of slack. Connectors shall match both the switch SFP optic module and the proposed fiber optic patch panel bulkheads.

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REVISION OF SECTION 614
ETHERNET SWITCH

The total number of optics and filters has been estimated in the table below. The quantities are for information only and the Contractor shall satisfy himself with the quantities shown. There must be a sufficient number of optics and filters to create a fully functional communication system as indicated in the plans. The Contractor shall work with Ciena prior to purchasing to verify the information in the table below.

λ (Wavelength) NM	No Of SFP Optics	No of Filters
1310	24	0
1430	16	16
1450	16	16
1470	16	16
1490	12	12
1510	12	12
1530	12	12
1550	12	12
1570	12	12
1590	12	12
1610	12	12
XFP 850 NM	1	
XFP 1550 NM	2	

CONSTRUCTION REQUIREMENTS

All Ethernet switches shall be installed with a basic configuration in conformance with Ciena by certified Ciena partner either prior to installation or at the installation site. Final configuration for data transport will be conducted by CDOT personnel after installation and basic configuration is performed and upon final approval and acceptance.

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 Ciena 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 Ciena, the item shall be removed and replaced at no additional cost to the project. Items shall also be replaced if any failures occur do to by manufacture defects, at no additional cost to the project, prior to the final acceptance.

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REVISION OF SECTION 614
ETHERNET SWITCH

A 30-day burn-in period shall commence for all Ethernet switches and its corresponding components, as defined herein, once final acceptance testing is completed. The burn-in period shall be used to detect and reject products that fail early in their operational life due to otherwise undetected manufacturing process or component defects. The burn- in period shall involve exposing the Ethernet switches and its components to the full range of expected operational and environmental conditions for a continuous 30 day period to expose any early failure rates or component defects. Products that continue to function properly following completion of the burn-in period shall be accepted, but those that fail shall be rejected as unsuitable and must be replaced by the Contractor at no expense to the Department.

REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR TOLL EQUIPMENT

DESCRIPTION

This work consists of furnishing and installing a rack mounted Uninterruptible Power Supply (UPS), batteries, transfer switch, disconnect switch, and power connections in a Contractor supplied Model 332 cabinet, side mounted cooling fan and polycarbonate base at locations shown in the plans. The UPS system shall be capable of running essential control electronics, communications equipment, AVI Antennas, Cameras, transaction beacons, and other miscellaneous equipment as noted in the Toll Layout Details, for at least 8 hours. The dual toll layout location at Station 116+75 shall also be powered by one UPS system and 332 Cabinet for up to 8 hours. The distance from the UPS to the control cabinet is approximately 110' for all toll layouts and this should be a consideration for power loss. The Toll equipment cabinet is located in the median and the UPS and cabinet is located outside of the roadway clear zone.

The UPS system shall be designed for a hot swap of components and shall not compromise existing operation of dynamic message signs or variable message signs. The unit shall provide for RS232 communication and contact closures for alarm functions.

MATERIALS

The UPS system shall provide "On-Line" dual conversion control. The UPS shall be rated per the following:

Input Voltage	85 VAC to 135 VAC line in neutral and 192VAC to 264VAC line to line
Input Frequency	48 to 62 Hz
Output Voltage	120 VAC +/- 3%120/240 VAC, 1-Phase, 3 Wire plus Ground, +/- 3% Output Frequency 60 Hz
Power	VA required of running the toll equipment for a single and multi direction toll point for up to 8 hours, based on 20 amps VA need.

The unit shall be temperature rated to operate from 0 degree C to +40 degree C.

The UPS system shall be capable of producing simultaneously-fully regenerated, conditioned power with true sine wave and continuous AC outputs with stand by capability.

The unit shall have a re-settable power event counter to record the number of power utility failures, a battery run-time counter and temperature compensated battery charging.

The UPS System shall be capable of providing continuous, fully conditioned (both voltage and frequency), regulated, sinusoidal (AC) power to selected devices such as controllers, modems, and 5 volt power supplies, and sign face drivers.

Wiring shall comply with national electrical code (NEC) standards and approved wiring methods. Properly rated SO/SJO cords shall be allowed to allow easy replacement of the UPS System.

The interconnect cable shall be protected with abrasion-resistant nylon sheathing.

The UPS shall consist of two major components, the Electronics Module and the Battery System.

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR TOLL EQUIPMENT

(a) The Electronics Module shall consist of the following:

1. True Sine wave, high frequency inverter.

2. Minimum 3-stage, temperature compensated, battery charger

6. For connection from the Electronics Module to the Battery System, a dedicated harness shall be provided with quick-release, keyed, circular connectors, and braided nylon sleeving over all conductors.

7. Local and remote control of UPS functions

8. Local and remote communications capabilities

(b) The Battery System shall consist of the following:

1. Shall meet the continuous 8 hour requirement to run sign electronics, communication equipment, and half of the sign face with all LEDs illuminated at daytime brightness levels.

2. The batteries shall be comprised of extreme temperature, deep cycle AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid) batteries that have been field proven and tested by the U.S. military.

3. Batteries shall be certified to operate at extreme temperatures from -40’C to +74’C.

4. The batteries shall be provided with appropriate interconnect wiring and a corrosion-resistant mounting trays and/or brackets appropriate for the location into which they will be installed.

5. Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells and heavy-duty plates to withstand shock and vibration.

(c) The UPS enclosure shall have forced air Cooling/Ventilation:

1. The UPS shall be forced air cooled by internally mounted, continuous fans.

2. Fan power shall be provided from the internal DC supply.

3. Air intake shall be through the front bottom of the unit, and air exhaust shall be out the rear top of the unit.

4. Intake and exhaust shall have bird/rodent mesh guard and filtration.

5. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR TOLL EQUIPMENT

The UPS System shall come standard with software, RS232 interface via a DB-9F connector, and Ethernet interface via RJ-45 connector allowing full, interactive, remote computer monitoring and control of the UPS functions. The software shall allow the user to set up all operational parameters either locally or remotely and test the functionality of the unit. The unit shall be capable of sending simple network management protocol (SNMP) alarm traps upon alarm conditions and also be configurable via built in web page interface.

The UPS System Alarm Function Monitoring shall come standard with a DB-9F connector with open collectors (40 V @ 20 mA) indicating:

- Loss of Utility Power
- Inverter Failure
- Low Battery

The UPS System Front Panel Controls shall come standard with Power ON, Cold (DC) Start, Alarm Silence, Battery Test, Bypass Breaker and DC/Battery Breaker.

Reliability shall be calculated with mean time between failure (MTBF) as 100,000 hours based on component ratings.

CONSTRUCTION REQUIREMENTS

Contractor shall provide detailed design and installation plans for Engineer approval prior to installation. Power feeding the sign shall first terminate in the ground mounted cabinet. Non-UPS power shall pass through the cabinet to power non-UPS loads. Power required for sign backup shall feed through the UPS system. A bypass switch, rated for the designed system, shall be installed to bypass the UPS in the event of UPS failure or for system maintenance. A disconnect switch shall also be installed to disconnect UPS and line power from the sign. The Contractor shall install the DMS UPS output into the DMS power distribution panel per sign manufacture recommendations. Serial and Ethernet cables shall be installed from the UPS system ground cabinet to the sign communication device location. All wiring shall conform to the latest version of the NEC.

The UPS equipment shall include a minimum two year warranty on parts and labor. Batteries shall include a minimum two year pro rated warranty. Vendor shall be responsible for processing warranty repairs.

A repair option shall be available for UPS equipment no longer covered by the warranty period. Repair cost shall include all labor and materials necessary to complete the repair. Vendor shall be responsible for processing non- warranty repairs.

REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR VARIABLE TOLL MESSAGE SIGN (VTMS)

DESCRIPTION

This work consists of furnishing and installing a rack mounted Uninterruptible Power Supply (UPS), batteries, transfer switch, disconnect switch, and power connections in a Contractor supplied Model 332 cabinet, side mounted cooling fan and polycarbonate base at locations shown in the plans. The UPS system shall be capable of running essential sign control electronics, communication equipment, **and two** full LED sign faces allowing messaged display, and sign communications/control for at least 8 hours. The sign specification is entitled Variable Toll Message Sign (VTMS).

The UPS system shall be designed for a hot swap of components and shall not compromise existing operation of dynamic message signs or variable message signs. The unit shall provide for RS232 communication and contact closures for alarm functions.

MATERIALS

The UPS system shall provide "On-Line" dual conversion control.

The UPS shall be rated per the following:

Input Voltage	85 VAC to 135 VAC line in neutral and 192VAC to 264VAC line to line
Input Frequency	48 to 62 Hz
Output Voltage	120 VAC +/- 3% 120/240 VAC, 1-Phase, 3 Wire plus Ground, +/- 3% Output Frequency 60 Hz
Power	VA required of running 2 VTMS signs at one location during a power outage for up to 8 hours. The unit shall be temperature rated to operate from 0 degree C to +40 degree C.

The UPS system shall be capable of producing simultaneously-fully regenerated, conditioned power with true sine wave and continuous AC outputs with stand by capability.

The unit shall have a re-settable power event counter to record the number of power utility failures, a battery run-time counter and temperature compensated battery charging.

The UPS System shall be capable of providing continuous, fully conditioned (both voltage and frequency), regulated, sinusoidal (AC) power to selected devices such as controllers, modems, and 5 volt power supplies, and sign face drivers.

Wiring shall comply with national electrical code (NEC) standards and approved wiring methods. Properly rated SO/SJO cords shall be allowed to allow easy replacement of the UPS System.

The interconnect cable shall be protected with abrasion-resistant nylon sheathing.

The UPS shall consist of two major components, the Electronics Module and the Battery System.

(a) The Electronics Module shall consist of the following:

1. True Sine wave, high frequency inverter.

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR VARIABLE TOLL MESSAGE SIGN (VTMS)

2. Minimum 3-stage, temperature compensated, battery charger

9. For connection from the Electronics Module to the Battery System, a dedicated harness shall be provided with quick-release, keyed, circular connectors, and braided nylon sleeving over all conductors.

10. Local and remote control of UPS functions

11. Local and remote communications capabilities

(b) The Battery System shall consist of the following:

1. Shall meet the continuous 8 hour requirement to run sign electronics, communication equipment, and half of the sign face with all LEDs illuminated at daytime brightness levels.

2. The batteries shall be comprised of extreme temperature, deep cycle AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid) batteries that have been field proven and tested by the U.S. military.

3. Batteries shall be certified to operate at extreme temperatures from -40’C to +74’C.

4. The batteries shall be provided with appropriate interconnect wiring and a corrosion-resistant mounting trays and/or brackets appropriate for the location into which they will be installed.

5. Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells and heavy-duty plates to withstand shock and vibration.

(c) The UPS enclosure shall have forced air Cooling/Ventilation:

1. The UPS shall be forced air cooled by internally mounted, continuous fans.

2. Fan power shall be provided from the internal DC supply.

3. Air intake shall be through the front bottom of the unit, and air exhaust shall be out the rear top of the unit.

4. Intake and exhaust shall have bird/rodent mesh guard and filtration.

5. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded

The UPS System shall come standard with software, RS232 interface via a DB-9F connector, and Ethernet interface via RJ-45 connector allowing full, interactive, remote computer monitoring and control of the UPS functions. The software shall allow the user to set up all operational parameters either locally or remotely and test the functionality of the unit. The unit shall be capable of sending simple network

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY FOR VARIABLE TOLL MESSAGE SIGN (VTMS)

management protocol (SNMP) alarm traps upon alarm conditions and also be configurable via built in web page interface.

The UPS System Alarm Function Monitoring shall come standard with a DB-9F connector with open collectors (40 V @ 20 mA) indicating:

- Loss of Utility Power
- Inverter Failure
- Low Battery

The UPS System Front Panel Controls shall come standard with Power ON, Cold (DC) Start, Alarm Silence, Battery Test, Bypass Breaker and DC/Battery Breaker.

Reliability shall be calculated with mean time between failure (MTBF) as 100,000 hours based on component ratings.

CONSTRUCTION REQUIREMENTS

Contractor shall provide detailed design and installation plans for Engineer approval prior to installation. Power feeding the sign shall first terminate in the ground mounted cabinet. Non-UPS power shall pass through the cabinet to power non-UPS loads. Power required for sign backup shall feed through the UPS system. A bypass switch, rated for the designed system, shall be installed to bypass the UPS in the event of UPS failure or for system maintenance. A disconnect switch shall also be installed to disconnect UPS and line power from the sign. The Contractor shall install the DMS UPS output into the DMS power distribution panel per sign manufacture recommendations. Serial and Ethernet cables shall be installed from the UPS system ground cabinet to the sign communication device location. All wiring shall conform to the latest version of the NEC.

The UPS equipment shall include a minimum two year warranty on parts and labor. Batteries shall include a minimum two year pro rated warranty. Vendor shall be responsible for processing warranty repairs.

A repair option shall be available for UPS equipment no longer covered by the warranty period. Repair cost shall include all labor and materials necessary to complete the repair. Vendor shall be responsible for processing non- warranty repairs.

REVISION OF SECTION 614
FIBER OPTIC TERMINATION PANEL

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing fiber optic termination panels in communication cabinets and node buildings for single mode fiber optic cables.

MATERIALS

All termination panels shall be manufactured using 16-gauge aluminum or equivalent and shall be finished with powder coat for durability. The termination panels shall be provided to accommodate either a 12 count lateral fiber optic cable or a 168 count backbone fiber optic cable. All termination panels shall be equipped with ST type bulkheads and be compliant with the Telcordia GR-326 Generic Requirements for Single Mode Optical Connectors and Jumper Assemblies. The manufacturer shall perform acceptance testing for insertion loss and return loss with the test certification provided with each patch panel.

All termination panels shall have a labeling scheme that complies with ANSI/TIA/EIA-606 and the details as shown on the Project Details Sheet.

The 6 port panels shall have hinged doors to provide future access to both the fiber fan out and the termination bulkheads. The panel shall be sized to accommodate the entry of the lateral fiber optic cable, fiber fan out, bulkheads, with the access door closed. The fiber optic patch panel shall be suitable for wall mounting and have dimensions not exceeding 5 inches (W) × 6 inches (L) × 2 inch (D). Each fiber optic patch panel shall include a flat polypropylene cassette, adapters, 6-fiber buffer tube fan-out kit (with 25 inch furcation tubing), strain relief boot, grommet tape, zip ties and wall mounting bracket. Terminations within the patch panel shall be polished with a physical contact (PC) finish.

24 port termination panels for lateral fiber optic cables shall be provided to accommodate twenty four (24) ports. The panels shall be provided with two (2) ST termination bulkhead 6 pack modules for fiber terminations as shown in the plans. The panel shall be provided with covers for the remaining spaces for future bulkhead installations and to inhibit dust to enter the inside of the termination panel. The termination panel shall have a slide out interior for access of the remaining lateral fibers and the back side of the bulkheads while minimizing disturbance to existing fiber and terminations.

168 port termination panels for backbone fiber optic cables shall be installed in the node buildings and shall be sized to accommodate one hundred and sixty eight (168) ports and mounted in the node buildings 19-inch equipment racks. A separate termination panel shall be furnished and installed for each backbone fiber optic cable.

The 168 port termination panel shall have a hinged door with label sheets for documentation of each port usage.

Bulkheads in all termination panels shall be metal. Plastic bulkheads will not be accepted.

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REVISION OF SECTION 614
FIBER OPTIC TERMINATION PANEL

CONSTRUCTION REQUIREMENTS

24 port termination panels shall be installed within communications cabinets and shall be mounted in locations which will allow for ease of access and shall not interfere with maintenance of the internal equipment. 24 port termination panels shall be installed in communications cabinet 19" equipment racks.

6 port termination panels for lateral fiber optic cables shall be installed at locations where either existing or proposed equipment will not allow for the installation of a 24 port termination panel.

The Contractor shall use proper strain relief inside the termination panel for the fiber cable and fiber fan out strands per the manufacturer's recommendations. The use of tape to secure the individual fanned out strands to the bottom of the termination panel shall not be allowed.

All hardware shall be installed in accordance with manufacturer's recommendations.

REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXING SFP

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

For this project the Coarse Wavelength Division Multiplexing SFP shall be a single wavelength Coarse Wavelength Division Multiplexing (CWDM) Small Form-Factor Pluggable (SFP) optic module for installation in a Ciena 3930 Carrier Ethernet Service Delivery Switch (SDS). There shall also be a matching CWDM SFP optic module installed in the corresponding Ciena 5150 or 5142 Carrier Ethernet Service Aggregation Ethernet Switch (SAS). All Coarse Wavelength Division Multiplexing SFP optic modules shall be provided from a manufacturer recommended by Ciena.

MATERIALS

The Contractor shall furnish and install the CWDM SFP optic modules in the wavelengths as shown in the item table below. This table describes optic modules for installation in Ciena 3930 Carrier Ethernet SDS Ethernet switches, Ciena 5150 Carrier Ethernet SAS switches and a 5142 Carrier Ethernet SAS switch.

Item Table – CWDM SFP Optic Modules for Ciena 3930 Carrier Ethernet SDS switches, Ciena 5150 Carrier Ethernet SAS switches and a 5142 Carrier Ethernet SAS switch.

Item Description	Item Number
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1430 NM, EXT. TEMP	XCVR-A80D43
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1450 NM, EXT. TEMP	XCVR-A80D45
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1470 NM, EXT. TEMP	XCVR-A80D47
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1490 NM, EXT. TEMP	XCVR-A80D49
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1510 NM, EXT. TEMP	XCVR-A80D51
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1530 NM, EXT. TEMP	XCVR-A80D53
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1570 NM, EXT. TEMP	XCVR-A80D57
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1590 NM, EXT. TEMP	XCVR-A80D59
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM, 1610 NM, EXT. TEMP	XCVR-A80D61

If for any reason the CWDM SFP optic modules are defective or are damaged at the time of installation by either the Contractor or by Ciena, the optic module shall be removed and replaced at no additional cost to the project. CWDM SFP optic modules shall also be replaced if any failures occur do to manufacture's defect, at no additional cost to the project prior to the final network acceptance.

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REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXING SFP

CenturyLink is the direct contracted equipment supplier of Ciena Corporation for the State of Colorado, Colorado Department of Transportation for networking equipment and associated network materials. For project equipment estimate quotations and purchasing, Contractors shall contact the following distributer representative:

State of Colorado, Colorado Department of Transportation
Project Equipment Estimate Quotations and Purchasing Supplier Representative.
Keith A. Glose
Premier Account Manager
CenturyLink Government
930 15th Street, 4th Floor, Denver, Colorado 80202
Telephone: 303-992-5567 Fax: 720-578-2694
E-Mail: keith.glose@centurylink.com

CONSTRUCTION REQUIREMENTS

For Ciena 3930 Carrier Ethernet SDS switch installations, a single CWDM SFP optic module shall be installed in each switch for CWDM data communications.

The Contractor shall ensure that the wavelengths of the CWDM SFP optic modules installed in the Ciena 3930 Carrier Ethernet SDS Ethernet switches match those installed in the corresponding Ciena 5150 or 5142 Carrier Ethernet SAS Ethernet switch to ensure proper data communications.

METHOD OF MEASUREMENT

Coarse Wavelength Division Multiplexing SFP optic modules for the Ciena 3930 Carrier Ethernet SDS switches and the 5150 and 5142 Carrier Ethernet switches will not be measured or paid for separately, but will be considered incidental to the Ethernet Switch pay item.

REVISION OF SECTION 614
DENSE WAVE DIVISION MULTIPLEXING (DWDM)

Dense Wave Division Multiplexing (DWDM)

Channel (#)	Frequency (GHz)	Wavelength (nm)	Channel (#)	Frequency (GHz)	Wavelength (nm)
1	190100	1577.03	37	193700	1547.72
2	190200	1576.03	38	193800	1546.92
3	190300	1575.37	39	193900	1546.12
4	190400	1574.54	40	194000	1545.32
5	190500	1573.71	41	194100	1544.53
6	190600	1572.89	42	194200	1543.73
7	190700	1572.06	43	194300	1542.94
8	190800	1571.24	44	194400	1542.14
9	190900	1570.42	45	194500	1541.35
10	191000	1569.59	46	194600	1540.56
11	191100	1568.11	47	194700	1539.77
12	191200	1567.95	48	194800	1538.98
13	191300	1567.13	49	194900	1538.19
14	191400	1566.31	50	195000	1537.40
15	191500	1565.50	51	195100	1536.61
16	191600	1564.68	52	195200	1535.82
17	191700	1563.86	53	195300	1535.04
18	191800	1563.05	54	195400	1534.25
19	191900	1562.23	55	195500	1533.47
20	192000	1561.42	56	195600	1532.68
21	192100	1560.61	57	195700	1531.90
22	192200	1559.79	58	195800	1531.12
23	192300	1558.98	59	195900	1530.33
24	192400	1558.17	60	196000	1529.55
25	192500	1557.36	61	196100	1528.77
26	192600	1556.56	62	196200	1527.99
27	192700	1555.75	63	196300	1527.22
28	192800	1554.94	64	196400	1526.44
29	192900	1554.13	65	196500	1525.66
30	193000	1553.33	66	196600	1524.89
31	193100	1552.52	67	196700	1524.11
32	193200	1551.72	68	196800	1523.34
33	193300	1550.92	69	196900	1522.56
34	193400	1550.12	70	197000	1521.79
35	193500	1549.32	71	197100	1521.02
36	193600	1548.52	72	197200	1520.25

ITU Grid: C-Band, 100 GHz Spacing
Note: for 200 GHz spacing use either odd or even numbered channels.

REVISION OF SECTION 614
SMALL FORM-FACTOR PLUGGABLE – 1310NM SFP

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

For this project the Small Form-Factor Pluggable – 1310NM SFP shall be a single wavelength Small Form-Factor Pluggable (SFP) optic module for installation in a Ciena 3930 Carrier Ethernet Service Delivery Switch (SDS). All Small Form Factor-Pluggable – 1310NM SFP optic modules shall be provided from a manufacturer recommended by Ciena.

MATERIALS

The Contractor shall furnish and install the 1310nm SFP optic module shown in the item table below. This table describes the optic module for installation in the Ciena 3930 Carrier Ethernet SDS switch. No matching 1310nm SFP optic module is required in the Ciena 5150 and Ciena 5142 Carrier Ethernet SAS switches.

Item Table – 1310nm SFP Optic Modules for a Ciena 3930 Carrier Ethernet SDS Switch.

ITEM DESCRIPTION	ITEM NUMBER
100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 10 KM, 1310 NM, EXTENDED TEMPERATURE	XCVR-A10Y31

If for any reason the 1310nm SFP optic modules are defective or are damaged at the time of installation by either the Contractor or by Ciena, the optic module shall be removed and replaced at no additional cost to the project. 1310nm SFP optic modules shall also be replaced if any failures occur do to manufacture's defects, at no additional cost to the project prior to the final network acceptance.

CenturyLink is the direct contracted equipment supplier of Ciena Corporation for the State of Colorado, Colorado Department of Transportation for networking equipment and associated network materials. For project equipment estimate quotations and purchasing, Contractors shall contact the following representative:

State of Colorado, Colorado Department of Transportation
Project Equipment Estimate Quotations and Purchasing Supplier Representative.
Keith A. Glose
Premier Account Manager
CenturyLink Government
930 15th Street, 4th Floor, Denver, Colorado 80202
Telephone: 303-992-5567 Fax: 720-578-2694
E-Mail: keith.glose@centurylink.com

CONSTRUCTION REQUIREMENTS

For Ciena 3930 Carrier Ethernet SDS switch installations, a single 1310nm SFP optic module shall be installed in each switch for data communications between 2 adjoining Ethernet switches. No matching 1310nm SFP optic module is required in the Ciena 5150 or 5142 Carrier Ethernet SAS switches.

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REVISION OF SECTION 614
SMALL FORM-FACTOR PLUGGABLE – 1310NM SFP

METHOD OF MEASUREMENT

Small Form-Factor Pluggable – 1310NM SFP optic modules for the Ciena 3930 Carrier Ethernet SDS switches will not be measured or paid for separately, but will be considered incidental to the Ethernet Switch pay item.

REVISION OF SECTION 614
BUFFER TUBE FAN OUT KIT

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

For this project, the Buffer Tube Fan-out Kit shall be furnished and installed on single mode fiber optic lateral cable ends in field communications cabinets.

MATERIALS

Buffer Tube Fan-Out Kits shall match the number of fiber strands in the lateral fiber optic cable. Buffer tube fan-out kits shall be compatible with the fiber optic cable being terminated and shall be color-coded to match the lateral fiber strand color. Fan out kit buffer tubes shall be 900 um. The buffer tube fan out kit fiber strand length shall be sufficient for routing and placement in the termination panel. All components of the fan-out kit shall be rated for outdoor use.

CONSTRUCTION REQUIREMENTS

The Contractor shall install fiber optic buffer tube fan-out kits on the lateral cable in each communications cabinet. The Contractor shall install fanned out cables on the ends of lateral fiber cable strands. Buffer tubes for lateral fiber strands shall be neatly coiled and secured within the field termination panels. Taping or leaving the buffer tubes unmanaged shall not be allowed.

METHOD OF MEASUREMENT

Buffer Tube Fan-Out Kit will be measured by the actual number of buffer tube fan-out kits installed, terminated, and accepted.

REVISION OF SECTION 614
OPTICAL TRANSCEIVER

Section 614 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Subsection 614.01 shall include the following:

For this project Optical Transceiver shall be a fiber optic modem and shall be furnished and installed in controller cabinets at the HOV gate controller and at the Node 2 regeneration building. The fiber optic modems shall be compatible with the existing system.

MATERIALS

Subsection 614.08 (n) Optical Transceiver, is hereby added to the Standard Specifications and shall include the following: (n) Optical Transceiver

1. *General System Requirements.* The unit shall be a multi-drop data modem designed to accept RS-232, RS-422 and 2 & 4 wire RS-485 signals and optically transmits these signals in either string or dual, counter-rotating, self- healing rings with either single or dual masters. The transceivers in controller cabinets shall be the shelf-mount, stand-alone type and the transceivers at the Node building shall be rack-mount.

   The unit shall consist of:

   A. Alarm dry contact output b] Selectable anti-streaming

   B. Local and remote loop back test/diagnostics d] Configurable as either a master or a slave

   C. Bus, single ring or dual redundant, counter rotating capabilities

   The unit shall have LED's to provide status information which shall include as a minimum:

   A. Link A – Receiving Optical Signal b] Link B – Receiving Optical Signal c] Alarm

   B. Data Transmit A present e] Data Receive A present f] Data Transmit B present

   C. Data Receive B present

   The unit shall operate on external power from a standard 3-prong receptacle that will supply 90 to 135 VAC 60 Hz.

   - Power 90-135 VAC 50-60 Hz < 2 Watts
   - Temperature -37°C to +74°C
   - Humidity 5-95% Non-Condensing
   - Fiber Interface ST Type Connectors
   - Fiber 1310 nm Single Mode fiber

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REVISION OF SECTION 614
OPTICAL TRANSCEIVER

Shelf Mount Units shall consist of:

- LED displays for Alarm, Power, Master/Slave, Fiber Link A, Fiber Link B, Data TX, Data RX, Handshake
- TX and Handshake RX.
- Able to be assigned a unique address without disassembly for network diagnostic identification.
- Have an Rs-232 interface to a Diagnostic computer
- Capable of being programmed as either a master or slave unit
- Have complete data re-clocking and regeneration
- Include the necessary power cord and transformer

Rack Mount Units shall consist of

- Have the same operational functions as the shelf mount Unit
- Connectivity to the remote computer network management and diagnostic software will be via RS-232 or USB ports.
- Fit in a standard 19" rack

2. *Testing Requirements*. The Contractor shall supply two units of optical transceivers to the Engineer for specification compliance testing and approval. If the product passes the specification compliance testing and approval evaluation, the Contractor will be notified to complete the order. If the product does not pass the specification compliance testing and approval evaluation by the Department, the test units will be returned to the Contractor. The Contractor shall supply additional units until satisfactory test results are achieved.

METHOD OF MEASUREMENT

Subsection 614.13 shall include the following:

Optical Transceiver will be measured by the number of units fully operational and tested in accordance with this specification or as directed by the Engineer and shall include all wiring for hook-up and related labor and material required for completion of the installation. All necessary documentation and testing shall also be included in the contract bid price.

REVISION OF SECTION 614
TRAFFIC MANAGEMENT SYSTEM BUILDING

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

The work shall include the fabrication, delivery, and installation of a Traffic Management System Building also referred to as the Node Building Shelter in the specifications and in the plans. The Node Building Shelter will house equipment that serves as the concentration point for field communications prior to integration with a communications backbone and shall house the communications backbone equipment, power distribution, standby power and miscellaneous equipment as specified in these specifications and as directed in the Plans.

The Manufacture shall construct and deliver a Node Building Shelter and associated equipment as shown on the Plans and as directed within these specifications. The term "associated equipment" shall be interpreted to include all components systems, and apparatus housed in, connected to, integral to the Node Building shelter.

Working drawings shall show Node Building Shelter design, foundation design, electrical design, and any other associated equipment as shown on the plans and as directed within these specifications shall be sealed by an Engineer registered in the State of Colorado and shall be submitted in accordance with subsection 105.02. for approval

The Traffic Management System Building shall be a prefabricated concrete facility installed at the site as indicated on the Plans.

The Traffic Management System Building shall be certified in the State of Colorado and conform to the 1997 Uniform Shelter Code (UBC), 1997 Uniform Mechanical Code, 1997 Uniform Plumbing Code, American with Disabilities Act (ADA) Accessibility Guidelines for Shelters and Facilities, National Fire Protection Association (NFPA) guidelines, and the 1996 National Electric Code. The structural design and details shall be stamped by a Colorado Professional Engineer.

The Traffic Management System Building shall nominally measure 28 feet by 12 feet unless otherwise directed by the Engineer.

The Node Building Shelters shall include:

(1) Interior and exterior lights as indicated and scheduled on the drawings

(2) 20-Amp/120V AC duplex outlets as indicated on the drawings

(3) Power distribution to all installed electronic equipment, air conditioning and other associated equipment installed.

(4) Lightning protection for the overall integrated structure.

(5) A single point grounding system for the shelter and associated equipment.

(6) Two (2 air conditioning units under lead lag control.

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REVISION OF SECTION 614
TRAFFIC MANAGEMENT SYSTEM BUILDING

(7) Rain hoods and filters, where applicable, for all ventilation fans, motorized louvers, air conditioner / heaters, doors, etc.

(8) Vandal protection cages for the air conditioner / heaters and external lighting

(9) Smoke alarms, over and under temperature alarms, door alarms, loss of power alarm, air conditioner / heater failure alarm

(10) A standby power generator

(11) A raised access floor system in the equipment room, color to be approved by the Engineer.

(12) Interior wall paneling colors and style to be approved by the Engineer.

(13) Exterior shall be stone aggregate, color and style to be approved by the Engineer.

(14) A double wide door for entry into the equipment room.

(15) A single door for entry into the equipment room.

All equipment and materials furnished for this Node Building Shelter shall be new and of prime quality and shall not have been used previously.

The Plans provide a suggested associated equipment layout and installation plan based on generic equipment and not necessarily the equipment selected by the Manufacture. To this extent, the Manufacture shall be responsible for providing:

(1) Cut sheets, shop drawings, and structural drawings of the Traffic Management System Building and its associated equipment to be installed shall be provided to the Engineer for review and approval.

(2) Structural drawings and calculations provided shall be stamped by a Colorado Professional Engineer.

(3) Geotechnical Soils Report provided shall be stamped by a Colorado Professional Engineer.

(4) Foundation drawings and generator slab drawings and calculations provided shall be stamped by a Colorado Professional Engineer.

The Manufacture shall provide commercial manuals on:

(1) Automatic transfer switch

(2) Air conditioner / heaters

(3) Transient Voltage Surge Suppressor

(4) Alarm system

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REVISION OF SECTION 614
TRAFFIC MANAGEMENT SYSTEM BUILDING

(5) Generator

(6) UPS Systems

(7) Rack-mounted power distribution modules

(8) All other supplied associated equipment where applicable.

Documentation is considered to be part of the Traffic Management System Building delivery.

Each item of equipment and all of its auxiliary equipment shall be warranted by the Manufacture against all defects in material and workmanship for a period of 1 year. The Traffic Management System Building itself and the generator shall be warranted for five years for materials, workmanship, and structural integrity. The air conditioner / heater compressors shall be warranted for five years where as the other air conditioner / heater components shall be warranted for parts and labor for one year

(1) *Human Safety.* All Node Building Shelter equipment shall comply with all commercial safety standards for electronic equipment and shall not contain any sharp edges. Power input requirements (i.e., voltage and current) shall be marked clearly on all Node Building Shelter equipment. All power interconnections shall be protected against inadvertent contact by maintenance personnel. No cabinet shall include any exposed voltage above 24 volts or exposed current above 100 mA. Protective covers shall be provided where required to prevent inadvertent power terminal contact by equipment technicians. Safety markings shall be included for any protective covers over high voltage and/or high current

(2) *System Safety.* Shorting or opening an interface shall not cause permanent damage to an interface circuit. Lightning protection for all copper signal circuits shall be provided. All connectors and cables shall be clearly marked. Similarly, all indicators and controls shall be clearly and accurately marked as to function. All power interconnections shall be protected against inadvertent contact by maintenance personnel.

(3) *Lightning Protection.* The Manufacture shall furnish and install a lightning protection system for the traffic management system shelter. The Manufacture shall make the entire installation in an inconspicuous manner so as not to mar the architectural design of the structure; provide an adequate number of air terminals; firmly anchor all air terminals; course the conductors properly and run them straight when they are supposed to be straight and make proper bends where bends are required; use the proper attachment for Node Building Shelter surface; attach conductors to the Node Building Shelter firmly so that they shall not come loose; see that all joints and connections are well made and shall stay that way; and make all required metal work connections in a permanent and durable manner. The course of all conductors shall be horizontal or downward, never upward. The completed system shall comply with the latest editions of the "Installation Requirements for Lightning Protection Systems, UL96A" and National Fire Protection Association's "Lightning Protection Code," NFPA 780. Adequate wire length shall be provided from this system to attach to the ground once the Node Building Shelter is in place.

(4) *Node Building Shelter Ground.* The Manufacture shall furnish and install a power grounding system in accordance with the Plans and the grounding electrodes and grounding electrode

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conductors shall be provided and installed (i.e., bonded) per the NEC. All noncurrent carrying metal parts of electrical or electronic equipment shall be separated by at least 6 feet from those of the lightning protection system, per Article 250.46 of the NEC. The Node Building Shelter shall include an interior halo ground ring that is interconnected through the power grounding electrodes. The halo ring shall facilitate a common bonding point for all Node Building Shelter equipment ground conductors and other loose metals. The grounding plates shall be connected directly to the buried ring and utilized for system grounding as indicated in the plans. Adequate wire length shall be provided from this system to attach to the ground once the Node Building Shelter is in place.

(5) *Air conditioner / Heater.* The air conditioner / heater system, its appurtenances, and its installation shall comply with the requirements of the NEC, the NFPA, and the air conditioner / heater manufacture recommendations. A rain shield for the air conditioner / heaters shall be provided on the Node Building Shelter exterior. The Manufacture shall furnish and install steel bar or wire cage security for air conditioner / heaters to prevent theft, vandalism, and entry to the facility. The steel bar or wire cage shall not interfere with the air conditioner / heater's normal operation and performance. Routine preventive maintenance (i.e., filter change), system control configuration, and electrical disconnect shall be feasible and convenient means of access to the system without complete disassembly of the steel-bar security. It shall not be possible to detach the air conditioner / heater security bars from the Node Building Shelter exterior.

(6) *Wire and Cable.* All wiring shall be installed in accordance with NEC. All conductor sizes shall be in accordance with NEC and shall be copper. Where wire and cable routing is not shown, and destination only is indicated, the Manufacture shall propose a routing and length required. All wire shall be new. Insulation shall have a 600-volt rating. In light fixtures and other high temperature applications, the insulation shall be rated 90 ° C.

Other areas shall use insulation rated 75 °C unless stated otherwise in other parts of these specifications and Plans. All conductors shall be suitable for the application intended. Conductors #10 and larger shall be stranded. Conductors #12 and smaller shall be solid.

Use type THW, THHN, or THWN insulation for feeders and branch circuits. Provide protection for exposed cables where subject to damage. Neatly train and lace wiring inside junction boxes, equipment, and panel boards. All wire and cable shall be installed in conduit (with obvious exceptions such as the interior cabinet wiring, etc.). Do not use wire smaller than 12 A WG for outlet power and lighting circuits.

Splices only allowed in junction boxes. Use plastic ties to support cable as needed. All splices shall have an electrical resistance not in excess of a 60ft. run of the conductor. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller. Use mechanical or compression connectors for wire splices and taps, 8 A WG and larger. Thoroughly clean wire before installing lugs and connectors. At all splices and terminations, leave tails long enough to cut splices out and completely re-splice.

(7) *Conduit.* All conduit runs and sizing shall be in compliance with the NEC unless larger conduit sizes are indicated on the drawings. Verify location and pathway of conduit runs before

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installation. Conduit shall be run in either flexible or rigid conduit under the false floor to junction boxes and then routed to equipment. All conduits and boxes shall be fastened to the Node Building Shelter structure.

(8) *Foundation Requirements.* The Manufacture shall provide a professional engineered signed and stamped Node Building Shelter foundation plan, generator pad, and calculations adequate for the Node Building Shelter specified herein. The foundation shall be a steel reinforced concrete structural grade-beam supported by caissons. The generator pad shall be a steel reinforced concrete thickened edge slab. The Manufacture shall have the foundation professional engineer perform a site soil survey as necessary for the proper foundation design and generator slab design for the site conditions. All concrete used in the grade beams shall have a minimum 4500 psi field compressive strength at 28 days, a minimum cement content of 615-660 lbs/cy yd, an air content of 5-8%, and a maximum water to cement ratio of 0.45. All concrete used in the caissons shall have a 4000 psi field compressive strength at 28 days, a minimum cement content of 610 lbs/cy yd, no minimum air content, and a maximum water to cement ratio of 0.45.

All reinforcing bars shall be ASTM A615, Grade 60. All concrete used in the generator slab shall have a minimum 4500 psi field compressive strength at 28 days, no minimum cement content, an air content of 5-8%, and a maximum water to cement ratio of 0.45. The configuration of the grade beam shall not restrict the installation or configuration of the entrance ramp to the shelter. The foundation and generator pad plan to be provided by the building Manufacture shall be delivered to CDOT for approval.

(9) *Traffic Management System Building - General.* The Node Building Shelter shall be dust-tight and watertight. The Node Building Shelter shall also be secured from vermin. The Node Building Shelter shall meet the structural specifications as set forth unless otherwise approved by the Engineer.

9.1. *Concrete.* All concrete shall conform to the requirements of the soils report. Any requirements in this specification that conflict with the soils report shall be superseded by the requirements in the soils report. Portland cement shall conform to ASTM C150 Type V. Sand shall conform to ASTM C33. Lightweight fine and coarse aggregates shall conform to ASTM C330. Air entraining admixtures shall conform to ASTM C260.All concrete work shall conform to ACI 318 shelter code requirements for reinforced concrete and shall have minimum 28-day compressive test strength of 4000 psi, Coarse aggregate shall be ¾ inch nominal size. Water shall be clean and potable. Cement aggregate shall be stored in a way that keeps them free from foreign substances that would affect their compatibility with the mixture and keep them from deteriorating.

The concrete shall have a density of 143 lbs/cf when cured. Concrete shall be cured in forms and protected from moisture loss, freezing and excessive heat until compressive strength reaches the required minimums. Any minor cracks and/or chips that do not affect the structural integrity of the panel or component shall be patched in accordance with ASTM C858. Severe cracks, spalling, etc. as evident once the Node Building Shelter has been delivered shall be evaluated by the Node Building Shelter manufacturer and the Engineer before repairs are attempted. CDOT may repair these areas and the cost of the repairs will be

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deducted from monies due the manufacture. Any appreciable impairment of the structural integrity shall be cause for rejection.

9.2. *Reinforcing Steel.* All reinforcing steel shall be sufficiently secured to withstand any displacement during the pouring operation. All bars shall be of intermediate grade, or hardcore billet steel conforming to ASTM A615 and or A706. All welded wire mesh shall be steel wire fabric conforming to the requirements of ASTM A 185.

9.3. *Roof.* The Node Building Shelter shall have a 4 inch thick (minimum) reinforced concrete, gable panel roof. The roof is to have a 2 inch perimeter drip lip. Minimum pitch shall be 6.25%. Roof reinforcement shall consist of #4 rebar and or welded wire-mesh. The rooftop surface and all joints and seems shall be water proof.

9.4. *Walls.* Walls shall be 4 inch thick (per ACI 318), flat reinforced concrete panels.

Wall reinforcement shall consist of #4 rebar and/or welded wire mesh. The Node Building Shelter walls shall have a two-hour fire rating as described in the latest edition of the UBC. Interior walls shall be steel studs with R-14 minimum polyisocyanurate insulation covered with ¾ inch thick plywood. The walls and ceiling shall be painted semi-gloss white. Floor to wall intersection shall be finished with 4 inch vinyl baseboard.

9.5. *Floor*. The floor shall be reinforced concrete, with 8 inch deep ribs and 2 inch thick flange. Ribs shall be spaced at 2 feet O.C. across the width of the Node Building Shelter and 4 feet along the length (minimum). The floor shall contain provisions for lifting the Node Building Shelter and securing it to the foundation. Floor reinforcement shall consist of #6 rebar, #4 rebar and/or welded wire mesh.

9.6. *Panel Connections.* Panel to panel connections shall be welded using steel plates cast into the floor, roof and walls. Steel plates shall conform to ASTM A36. Welding shall conform to AWS D1.1 and AWS 01.4. Panel construction shall conform to ACI 318. All joints and seems shall be water proof.

9.7. *Structural Loading.* The Node Building Shelter floor shall be designed to support 15 lbs/sq ft dead load weight along with any live and dead loads imposed by the suspended floor when supported on a perimeter grade beam foundation. The roof shall be designed to support 10 lbs/sq ft dead load and 30 lbs/sf live load. The Node Building Shelter shall be designed to withstand winds of 150 miles per hour, exposure D. The Node Building Shelter shall be designed to exceed seismic zone 4 requirements.

9.8. *Weather Resistance.* The Node Building Shelter shall completely weatherproof. Each structural Panel shall be impregnated with a chemical moisture barrier to prevent seepage (Thoroglaze). All panel joints (wall to ceiling, wall to wall and wall to floor) shall be sealed with a permanent no-caulk weather seal (closed cell expanded neoprene). The wall to floor joint shall utilize a step joint, while all other joints shall have a groove/step joint all sealed

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with pre-compressed sealant tape. The doorways shall include a step-joint threshold and a drip overhang over the top of the doorframe.

9.9. *Exterior Finish.* The exposed reveals shall be-painted with sand textured concrete paint. The color shall be Federal Color Number 30450. Samples of the painted exterior finish shall be submitted to and approved by the Engineer.

9.10. *Node Building Shelter Dimensions.* The outside dimensions of the Node Building Shelter shall be at least 12 feet in width and 28 feet in length. The interior ceiling height shall be at least 8.5 feet in height after installation of the false floor.

9.11. *Raised Access Floor System.* A raised access floor system shall be designed, engineered, fabricated and installed within the Traffic Management System Building equipment room to comply with performance requirements per test methods and references specified or, if not specified, per the manufacturers standard methods. The raised access floor system shall have a minimum height of 8 inch as measured from the Traffic Management System Building floor. The system shall not alter the A.D.A compliant entry guidelines into the Traffic Management System Building nor that for mobility issues. The completed floor system shall be rigid, free of vibration, free of rocking panels and shall provide a smooth uniform floor surface. The overall floor shall be level within plus or minus 0.5 inch in 10 feet non-cumulative. The access floor system shall consist of the following components:

Steel panels meeting the following requirements:

a) The panels shall be modular, removable and shall measure 24 inch by 24 inch.

b) The panels shall consist of a top steel sheet welded to a formed steel bottom pan.

c) The panels shall be easily removable by one person with a lifting device, which shall be provided by the Manufacture, and shall be interchangeable except where cut for special conditions.

d) Each panel shall support a concentrated load of 1000 lbs per square inch placed on an area at any location on the panel, with a maximum beam deflection of 1/8 inch.

e) Each panel shall support a uniform load of 250 lbs per square inch placed on an area at any location on the panel with a maximum beam deflection of 1/16 inch.

f) Each panel shall withstand a load of 2400 lbs per square inch placed on an area, at any location on the panel, without failure.

g) Covering material for the panels to provide a low static, easily maintainable floor, that is slip resistant when wet. The covering shall be a minimum of 1/8 inch thick pressure laminate in color approved by the Engineer. The covering shall be a surface sheet over a melamine-impregnated sheet with the core material being phenolic-impregnated kraft

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papers. The covering shall be bonded to the. steel panel with a moisture resistant adhesive in accordance with the adhesive manufacturer's recommendations.

Adjustable height pedestal assemblies to support the steel panels. The pedestal assemblies shall meet the following requirements:

a) Pedestal assemblies shall be corrosion-resistant, aluminum or steel construction, and shall provide an adjustment range of +/- 1 inch.

b) Pedestal assemblies shall provide a means of leveling and locking the assembly at a selected height, which requires deliberate action to change height setting and prevents vibration displacement.

c) Threaded rods shall provide a specially designed anti-rotation device, such that when the head assembly is engaged in the base assembly, the head cannot freely rotate.

d) The pedestal assembly shall provide an 8000 lbs axial load without permanent deformation.

e) Pedestal assembly shall provide an average overturning moment of 8 lb-feet when glued to a clean, uncoated concrete surface. The pedestals shall adhere to the concrete floor with a sealer recommended by the manufacturer.

9.12. *Node Building Shelter Lighting.* The interior Traffic Management System Building lighting shall be ceiling-mounted general-purpose fluorescent lighting fixtures. Each light shall be equipped with 48-inch, 32-watt T-8 fluorescent tubes and full width reflectors. The ballast shall be electronic 120V, 60 Hz complying with Federal Energy Efficiency Standards. Interior lighting shall be controlled by two different wall-mounted 3-way switches located for easy access at each entrance. Exact location of the ceiling mounted fixtures shall be determined by the Manufacture based on his final equipment installation. Fixture placement shall be based on best visibility for maintenance operations. Two (2) vandal-resistant and weatherproof exterior lighting fixtures shall be provided as indicated on the plans. The fixture shall be powered by120V, 60 Hz, The exterior lighting shall be activated by motion within 10 feet or less of the door with activation only during dusk to dawn.

9.13. Equipment Room Exterior Door. The door shall be constructed of 18 gauge galvanized steel, full flush, windowless, and painted to match exterior and interior. One door shall be doublewide with minimum dimensions of 7 feet in height and 6 feet in width. The other door shall be a minimum dimension of 7 feet in height and 3 feet in width. The hinges and other exterior hardware shall be stainless steel or other acceptable corrosion proof material. The hinges shall use flush-type, non-rising pins with concealed setscrews for security against vandalism. The doors shall include a neoprene gasket which, when closed, effectively prevents the entrance of air, blowing sand, dust, and water. A weather strip shall be provided

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at the bottom of the door. The doors lock shall be of a non-corrosive material and shall utilize a key that is interchangeable and usable with previous traffic management system shelters. The doors shall contain an alarm (magnetic sensor) to detect opening; this alarm shall be integrated with the Node Building Shelter alarm terminal strip. The doors shall contain an astragal. The doors shall have a four-sided frame and shall be level with the raised floor system.

9.14. Electrical. The Manufacture shall provide all electrical wiring, meter enclosure, power distribution panel(s), grounding, power protection, and lightning protection as required. Install, operate, and test the equipment from the power utility meter location to the power inputs of all associated equipment and electrical/electronic apparatus prior to shipment. All power cabling shall comply with the NEC. Grounding commonality with commercial utility power shall be provided. Grounding shall comply with the NEC and IEEE 1100, "Recommended Practice for Powering and Grounding Sensitive Electronic Equipment" as referenced for a single-point grounding system and as specified and indicated in the Plans.

The Manufacture shall provide a steel 6 inch x 6 inch raceway the length of the Node Building Shelter (28 feet) under the raised access floor at the middle point of the shelter for the purposes of future routing of equipment wiring.

There shall be two lateral raceway connections directed towards the conditioned power panel location and the floor access hole.

9.15. Service and Distribution. For information only, the power service provided to this Node Building Shelter shall be 120/240 VAC 400 amp, single phase, 60Hz, three wire and ground. CDOT will install a temporary meter through a separate project. The building manufacture is required to uninstall this temporary meter and connect the service line to the permanent service disconnect switch / meter housing provided on the exterior of the building. The telephone service shall be a 1 MB line. CDOT will install a temporary demark through a separate project. The building manufacture is required to uninstall this temporary demark and install the service line to the permanent demark provided on the exterior of the building.

9.16. Automatic Transfer Switch. The Automatic Transfer Switch (ATS) shall transfer the load from the utility to the generator. The ATS shall be a double throw switch furnished and installed at locations as shown on the Plans or as approved by the Engineer. Switches shall be of the type approved, indicated and specified herein. The ATS shall have a NEMA Type 1 rating and meet UL 98. Lugs shall be front removable and UL Listed for aluminum or copper. All current carrying parts shall be plated to resist corrosion. Switch operating mechanism shall be 3-pole and rated at 400 ampere. Provisions shall be made for padlocking the switch in the OFF position. Switch covers shall be attached with welded pin-type hinges. The switch enclosure shall be finished with gray baked enamel paint that is electrodeposited on cleaned, phosphate pretreated steel (Type 1). The enclosure shall be supplied with a metal nameplate that includes NORM-OFF-EMER markings.

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9.17. Service Disconnect Switch (SDS). The SDS shall be furnished and installed at locations as shown on the drawings. The SDS shall be of the type approved, indicated and specified herein. The SDS shall be manufactured in accordance with the following standards UL 98 - Enclosed and Dead Front Switches. The SDS shall be fused and suitable as use for service equipment and labeled for this application. All switches shall have switchblades which are visible when the switch is OFF and the cover is open. Lugs shall be UL Listed for 90°C conductors, aluminum or copper. All current-carrying parts shall be plated to resist corrosion. The switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started. The operating handle shall be an integral part of the box and not the cover. Provisions shall be provided for padlocking the switch in the OFF position. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel, NEMA Type-3R. The SDS shall be heavy duty, rated for 240Vac and 400 amps. The I2t and Ip ratings shall be in accordance with UL-489. Provide with Class-R 400-amp fuses.

9.18. Main Power Distribution Panel board. The panel boards shall be located on an inside wall of the shelter. All breakers shall be sized to accommodate the Manufactures selected equipment and or based on equipment manufacturer recommendations.

Panelboard Interior:

a) The Main Power Distribution Panelboard shall be rated for 120/240 VAC, 400-Amp, 1-Phase. Branch Circuit and UPS Distribution Panelboards shall be main circuit breaker type, rated for 120/240VAC, 200-amp, 1-phase; main circuit breaker size shall be as scheduled. The AIC rating of all Panelboards shall be as scheduled.

b) Provide one continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers. The bussing shall be fully rated. Panel board bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. The bus shall be copper.

c) All current-carrying parts shall be insulated from ground and phase-to-phase by Noryl high dielectric strength thermoplastic or equivalent.

d) Split solid neutral shall be plated and located in the main compartment so all incoming neutral cable is the same length.

e) Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twist outs covering unused mounting space.

f) Name plates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format; Interiors

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shall be field convertible for top or bottom incoming feed. Main and sub feed circuit breakers shall be vertically mounted.

Main Circuit Breaker:

a) The main circuit breaker shall have an overcenter, trip-free, toggle mechanism that shall provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40°C ambient environment. Thermal elements shall be ambient compensating above 40°C.

b) Two-pole circuit breakers shall have common tripping of all poles.

c) Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.

d) Lugs shall be UL listed to accept solid or stranded copper and aluminum conductors.

e) Lugs shall support conductors that have a temperature rating of 75°C sized according to NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.

Branch Circuit Breakers:

a) Circuit breakers shall be UL listed.

b) Molded case branch circuit breakers shall have bolt-on type bus connectors.

c) Circuit breakers shall have an overcenter toggle mechanism that shall provide quickmake, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two-pole circuit breakers shall have common tripping of all poles.

d) There shall be two forms of visible trip indication: The breaker handle shall reside in a position between ON and OFF and there shall be a red indicator appearing in the clear window of the circuit breaker housing.

e) The exposed faceplates of all branch circuit breakers shall be flush with one another.

f) Lugs shall be UL listed to accept solid or stranded copper and aluminum conductors.

g) Lugs shall support conductors that have a temperature rating of 90°C, sized according to NEC Table 310-16. Branch circuit breakers rated 30 amperes and below shall be UL Listed for 60°C rated wire.

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Enclosures:

a) NEMA Type 1

b) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

c) All doors shall be equipped with a tumbler-type vault lock and two additional trunk-type latches. All lock assemblies shall be keyed alike. Two keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.

d) Maximum enclosure dimensions shall not exceed 20 inch wide and 6.5 inch deep.

Installation:

a) Install panel boards in accordance with manufacturer's written instructions, NEMA PB, 1.1, and NEC standards.

b) Anchor panel boards to structure and make branch circuit connections.

c) Inspect complete installation for physical damage, proper alignment, anchorage, and rounding.

d) Measure steady state load currents at each panel board feeder; rearrange circuits in the panel

e) board to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits,

f) Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

9.19. Transient Voltage Surge Suppression (TVSS) A TVSS designed for permanent connection and service entrance application' shall be installed at the Traffic Management System Building as a means of power protection from damaging transients and electrical line noise. By definition, the term TVSS describes the equipment necessary for the protection of all AC electrical circuits from the effects of lightning' induced voltages and utility substation switching. The installation shall allow for servicing of the unit without interrupting power to the loads. The TVSS shall be designed to operate in a single phase, 120/240V AC, 3-wire, 60Hz system with protection modes from line to neutral, line to ground, and neutral to ground. The unit shall have maximum surge current rating of 100kA. The unit shall be mounted in a NEMA 1 enclosure and provide visual failure indication and communicate them via relay contacts to the Node Building Node Building Shelter alarm system. The TVSS shall be based on metal oxide varistor (MOV) technology with MOV s in parallel and individually fused. The TVSS shall be UL 1449 listed, and tested and approved for ANSI/IEEE C62.41-1991. Categories A, B, and C. The TVSS shall be installed in

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accordance with the manufacturers printed instructions to maintain warranty. No testing shall be required.

9.20. Grounding and Bonding. The grounding design for all Node Building Shelter equipment shall accomplish at least the following:

a) Personnel and equipment protection from electrical hazards.

b) Prevent voltage potentials in the grounded power conductors of Node Building Shelter equipment.

c) Provide a single point grounding system for all associated equipment, enclosures, racks, drawers, assemblies, and subassemblies (i.e., chassis/rack) at each Node Building Shelter site.

d) Prevent static charge accumulation that could promote electromagnetic interference or constitute a shock hazard to personnel.

e) Provide a fault current-to-ground path.

Safety considerations shall require the chassis or enclosures for electrical equipment to be grounded to minimize shock hazards to personnel. Proper grounding methods shall be implemented to minimize any noise voltage generated by currents from two or more circuits flowing through a common ground impedance and to avoid creating ground loops susceptible to magnetic fields and differences in ground potential. The Manufacture shall implement grounding designs as specified in the specifications and on the Plans.

9.21. Grounding Configuration. The grounding system shall be composed of a buried ring, interior halo, ground connections, floor ground system, and rods as required.

A horizontal ring shall completely encircle the Node Building Shelter (buried ring). This wire shall be solid tinned copper wire of #1/0 AWG or larger. The buried ring shall not be closer than 2 feet from the Node Building Shelter foundations, and shall be exothermically welded to each ground rod. The buried ring depth shall be below the frost line of the installation site. The buried ring shall be tested after installation, and its resistance to earth ground shall be less than 10 ohms. The testing shall use the Biddle Instruments Model DET2/2 Digital Ground Tester or equivalent and follow all manufacturers' instructions.

The halo ground shall consist of a minimum #2 AWG wire located approximately 6 inches below the finished ceiling and shall completely encircle the equipment room. The halo shall be utilized for equipment grounding and for grounding any other loose metals. The wire shall be green insulated stranded copper, bare stranded copper, or bare tinned solid copper. Each corner of the room shall have an omni-directional drop as indicated on the Plans. The wire size of the omni-directional drop shall be the same size and type as the halo ring. If solid tinned wire is used, the drop shall be one continuous wire and connected to the buried ring. If insulated wire is used, the drop shall extend to the floor, and then be connected in the same

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manner as the halo to a solid tinned wire of the same size of which shall be attached to the buried ring.

The drop, shall leave the Node Building Shelter and be attached to the buried ring through penetrations of 45-degree angles (to minimize ground drop bend radii). The Node Building Shelter penetrations are expected to be no more than 1 inch in diameter. CDOT shall provide the subgrade grounding ring as indicated in the plans. The manufacture shall connect the Node Building Shelter to the subgrade grounding ring.

The interior ground connections of the halo ring shall be mechanical crimp. A one-hole copper ground lug shall be used for equipment connections. An oxidizing preventative compound shall be applied to all mechanical connections, and paint shall be removed as necessary to insure positive bounding of all grounded equipment.

All external, buried connections shall be of the exothermically welded type. These include, but are not limited to, halo drops to ground rods, buried ring to ground rod, and halo drops to the buried ring.

The Manufacture shall provide and implement all Node Building Shelter grounding necessary on the interior to accommodate the associated power and lightning protection systems as indicated in the plans.

There shall be driven ground rods located at each comer of the Node Building Shelter as indicated in the Plans. The rods shall be made of copper clad high-strength steel with minimum dimensions of 3/4 inch by 10 feet. The rods shall be located at least 2 feet from the edge of the foundations, and driven such that the top of the rod is below the frost line of the installation site. The rods shall be exothermically welded to the buried ring.

A copper grounding plate located inside the Node Building Shelter shall be the connection point for system grounding and be directly connected to the buried ring.

The utility ground conductors for the Node Building Shelter system ground shall be bonded at the service disconnect switch. All utility or service grounding shall conform to Article 250 of the National Electric Code.

The raised access floor shall have a grounding ring wire laid under the raised access floor and on top of the Node Building Shelter concrete floor. Each floor pedestal assembly shall be connected to the floor ground ring. The floor ground ring will not be connected to the Node Building Shelter grounding system, electrical grounding system, or lightning protection system.

9.22. *Electric service.* The meter enclosure necessary for the Node Building Shelter shall be obtained from Utility Company (contact Region 4 Utilities: Jim Thrush at office number: 970-350-2284 email: jim.thrush@state.co.us) to coordinate the meter enclosure, weather head, conduits, and wire from the underground service through the meter enclosure to the service disconnect switch.

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The electric service for the Node Building Shelter shall be an underground line in conduit from an adjacent utility pole-mounted transformer, or pad-mounted transformer. The Contractor shall coordinate and provide the underground service from the adjacent pole to a new power meter installed at the Node Building Shelter location. The Contractor shall obtain the State electrical permit for the Node Building Shelter and the service connection. The service to the Node Building Shelter shall be120/ 240-VAC, 1-Phase, 400-Amp.

9.23. Generator. The work shall include obtaining and installing a generator and all necessary conduit and wiring to connect the generator to the Node Building Shelters automatic transfer switch. This work shall include all necessary conduits, wires, enclosures, equipment, materials, and personnel.

Generator Materials

The generator system shall be capable of installation in an exterior uncovered setting. The generator set will be of the lasted commercial design and will be complete with all of the necessary accessories for complete and operational installation as shown on the plans, drawings, and specifications herein. The equipment supplied and installed shall meet the requirements of the National Electrical Code, along with all applicable local codes and regulations. All equipment shall be new and of current production of a national firm that manufactures the generator set and controls, transfer switches, switchgear, and assembles the generator sets as a complete and coordinated system. There will be one source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

Equipment

a) The generator shall be rated at not less than 77-kW/77-kVA at 120/240-VAC 1-Phase, and shall include an enclosed molded-case 400-Amp, 2-Pole output circuit breaker. The generator shall be capable of this rating while operating in an ambient condition of 90°F and 4800 feet above sea level.

b) Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base

c) The unit shall be supplied with all hardware to bolt to a concrete slab.

Engine - The engine shall be equipped with the following:

a) An electronic isochronous governor capable of +0.5% steady-state frequency regulation.

b) 12 Volt positive engagement solenoid shift-starting motor.

c) 70-Ampere minimum automatic battery charging alternator with solid-state voltage regulation.

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d) Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.

e) Dry-type replaceable air cleaner elements for normal applications.

f) The engine shall be fueled with LP gas and be supplied with a unit-mounted electric solenoid fuel shut-off valve, flexible fuel line, and secondary fuel pressure regulator.

g) The engine shall have a minimum of 8 cylinders, and be liquid-cooled by a unit-mounted radiator, blower fan, water pump, and thermostats. This system shall properly cool the engine with up to 0.5 inches H20 static pressure on the fan in an ambient temperature up to 122F/50C.

Alternator

a) The alternator shall be of a permanent magnet brushless design

b) The alternator shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed stator for smooth voltage waveform. The insulation shall meet the NEMA standard (MG1-33.40) for Class H and be insulated with epoxy varnish to be fungus resistant per MIL 1-24092. Temperature rise of the rotor and stator shall be limited to 130°C. The excitation system shall be of brushless construction controlled by a solid- state voltage regulator capable of maintaining voltage within +/- 2% at any constant load from 0% to 100% of rating. The regulator must be isolated to prevent tracking when connected to SCR loads, and provide individual adjustments for voltage range, stability and volts-per-hertz operations; and be protected from the environment by conformal coating.

c) The generator set shall meet the transient performance requirements of ISO 8528-5, level G-2.

d) The alternator excitation shall be of a permanent magnet exciter design.

e) The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current support devices.

f) The alternator having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

Controller

a) Set-mounted controller capable of facing right, left, or rear, shall be vibration isolated on the alternator enclosure. The controller shall be capable of being remote-mounted. The microprocessor control board shall be moisture proof and capable of operation from -40^{o}C to 85^{o}C. Relays will only be acceptable in high-current circuits.

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b) Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine.

The controller shall include the following features:

i. Fused DC circuit.

ii. Complete 2-wire start/stop control, which shall operate on closure of a remote contact.

iii. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.

iv. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.

v. Cranking cycler with 15-second ON and OFF cranking periods.

vi. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.

vii. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, or overspeed is received.

viii. Engine cool down timer factory set at 5 minutes to permit unloaded running of the standby set after transfer of the load to normal.

ix. 3-position (Automatic-OFF-TEST) selector switch. In the TEST position, the engine shall start and run regardless of the position of the remote starting n contacts. In the Automatic position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open. In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.

x. Alarm horn with silencer switch per NFPA 110.

c) Standard indicating lights to signal the following shall be included:

i. Not-in-Auto (flashing red)

ii. Overcrank (red)

iii. Emergency Stop (red)

iv. High Engine Temperature (red)

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v. Overspeed (red)

vi. Low Oil Pressure (red)

vii. Battery Charger Malfunction (red)

viii. Low Battery Voltage (red)

ix. Low Fuel (red)

x. Auxiliary Prealarm (yellow)

xi. Auxiliary Fault (red)

xii. System Ready (green)

d) Test button for indicating lights.

e) Terminals shall be provided for each indicating light above, plus additional terminals for common fault and common prealarm.

Instrument Panel

a) The instrument panel shall include the following:

b) Dual range voltmeter 3 1/2-inch, +/- 2% accuracy

c) Dual range ammeter 3 1/2-inch, +/- 2% accuracy.

d) Voltmeter-ammeter phase selector switch.

e) Lights to indicate high or low meter scale.

f) Direct reading pointer-type frequency meter 3 1/2-inch, 0.5% accuracy, 45 to 65 Hz scale.

g) Panel-illuminating lights.

h) Battery charging voltmeter.

i) Coolant temperature gauge.

j) Oil pressure gauge.

k) Running-time meter.

l) Voltage-adjust rheostat

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Accessories

a) An 80% rated line circuit breaker of 400 amperes, 600 volt rated, molded case type, generator mounted.

Engine block heater. Thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA-99 and NFPA-110, Level 1.

A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished which protects the generator from damage due to its own high current capability. This breaker shall not trip within the 10 seconds specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition. This breaker shall not automatically reset, preventing restoration of voltage if maintenance is being performed. A field current-sensing breaker will not be acceptable.

b) Weather housings shall be constructed of rugged steel, cleaned, phosphated, and electrocoat painted inside and out with rust inhibiting primer and exterior coat of the manufacturer's standard color. Side panels will be lockable and easily removed for servicing.

c) Battery rack, and battery cables, capable of holding the manufacturer's recommended batteries, shall be supplied.

d) 6-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient temperatures from -40^{o}C to +60^{o}C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.

e) The engine exhaust silencer shall be coated to be temperature and rust resistance, rated for critical application. The silencer will reduce total engine exhaust noise by 25-35 dB(A).

f) Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.

g) Two flexible fuel lines rated at a minimum of 257^{o}F and 100 psi ending in pipe thread.

h) Generator rodent guards. The generator set shall conform to the requirements of the following codes and standards:

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.

2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.

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3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

4. IEC8528 part 4. Control Systems for Generator Sets

5. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.

6. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

7. Mil Std 461D –1993. Military Standard, Electromagnetic Interference Characteristics.

8. Mil Std 462D - 1993. Military Standard, Measurement of Electromagnetic Interference Characteristics.

9. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

10. NFPA99 – Essential Electrical Systems for Health Care Facilities

11. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

12. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed

Generator Construction Requirements

The generator shall be installed in accordance with the manufactures recommendations. It shall be leveled on the pad. It shall be bolted to the pad in accordance with manufactures recommendations. CDOT will provide the concrete pad as indicated in the plans.

A site test shall be performed by the manufacture. The site test shall include the following:

a) Site Tests: An installation check, start-up, and Node Building Shelter load test shall be performed by the generator manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

b) Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.

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c) Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, alternator strip heaters, remote annunciator, etc.

d) Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the shelter, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.

e) Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test. An external load bank shall be connected to the system if sufficient Node Building Shelter load is unavailable to load the generator set to the nameplate kW rating.

9.23. Lightning Protection. The Manufacture shall provide a complete lightning protection system as shown in the Plans and as specified herein.

9.24. *Traffic Management System Building Environmental Monitoring and Alarming*. The Traffic Management System Building shall contain sensors for detecting:

a) Over and under temperature conditions

b) Prime power loss

c) Smoke alarm

d) Door open

e) Air conditioner / heater failure

All discrete alarm outputs shall be wired to a terminal block located at an equipment rack. The terminal block terminals and wires shall be labeled so as to designate the alarm. The terminal block shall be documented in the electrical schematics as well.

Smoke alarm with a dual chamber ionization detector and an alarm relay module installed in a UL listed junction box. The smoke alarm shall be 120 V AC and UL listed.

Over and under temperature alarms shall be a bimetallic coil sensing element and an adjustable temperature range of -1 ° C to 43 ° C. The temperature alarm shall have gold-plated, normally open, dry alarm contacts and shall be UL listed.

9.25. Traffic Management System Building Air Conditioning. The Manufacture shall furnish and install two self-contained wall mount air conditioner / heaters suitable for outdoor use. The units shall be completely factory assembled and tested and shall include compressor, indoor

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and outdoor coils, fans and motors as required, pre-wired controls, interconnecting refrigerant tubing, wiring, disconnects, and other necessary components mounted in a corrosion resistant cabinet. The units shall be UL approved and ARI Standard 210-81 certified.

Each ACU shall have an SEER/EER rating of 10 or higher at ARI conditions of 20° F wet bulb, 25° F dry bulb entering indoor air, and condenser entering air temperature of 35° F dry bulb energy. The total net cooling minimum capacity of the individual units shall be 56,500 BTUH or greater, and sensible capacity shall be 45,600 BTUH or greater at ARI conditions stated above. Electric strip heat of 10kW shall be provided integral to the units. The compressor shall be a hermetic-type unless otherwise approved by the Engineer. The refrigeration circuit shall include high and low pressure switches with a lockout relay. The contacts of the lockout relay shall be used to represent air conditioner / heater failure and shall be connected to the alarm terminal blocks.

The condenser and evaporator coils shall be constructed of aluminum plate fins mechanically bonded to seamless copper tubes. Outdoor fans shall be direct driven, slow speed propeller type for quiet operation. An economizer shall be factory installed within the cabinet of the air conditioner / heater. Slip-in economizers are not acceptable. The economizer shall include an enthalpy sensor to control the damper by measuring the total heat content of the outside air.

The air conditioning system shall include a lead/lag controller with thermostat with temperature adjustments over a minimum range of 15°C to 35°C. The air conditioner / heater controller shall have a programmable, 7 -day, 24-hour clock with battery backup selectable for automatic air conditioner / heater switch over. It shall be possible to activate both air conditioner / heaters to accelerate cooling of the Node Building Shelter when the shelter has reached a high ambient temperature.

CONSTRUCTION REQUIREMENTS

Shop drawings shall be submitted for approval on all components of the Node Building Shelter and generator.

Foundation and generator slab drawings and calculations shall be submitted for approval.

Measurement will be based on one complete Node Building Shelter delivered and installed with an operational electrical system and an operational generator system. Delivery of the Node Building Shelter shall also include all warranty and equipment documentation. Any equipment necessary for the delivery and installation of the Node Building Shelter at the site shall not be measured and paid for separately but shall be included in the price. Costs to have a generator manufacture representative on site for installation and startup shall not be measured and paid for separately but shall be included in the price. Any traffic control necessary for the building delivery and installation shall not be measured and paid for separately but shall be included in the price.

Delivery of the Node Building Shelters shall be made to SH-66 Parking and Ride, and Fort Collins Rest Area, according to plans sheets 56, and 57 of this project. Installation and testing work shall be completed by December 30, 2014.

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MATERIALS

Conduit:

References

A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.

B. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.

C. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

D. NEMA RN 1 - PVC Externally-Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.

E. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

F. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

Materials

A. Rigid Metal Conduit and Fittings:

1. Rigid Steel Conduit: ANSI C80.1; hot-dip galvanized.

2. PVC Externally Coated Conduit: NEMA RN 1; rigid steel conduit with external PVC coating and internal galvanized surface.

3. Fittings and Conduit Bodies: NEMA FB 1; threaded type, material to match conduit.

B. Intermediate Metal Conduit (IMC) and Fittings:

1. Conduit: Hot-dipped galvanized steel.

2. Fittings and Conduit Bodies: NEMA FB 1; use fittings and conduit bodies specified above for rigid steel conduit.

C. Electrical Metallic Tubing (EMT) and Fittings:

1. EMT: ANSI C80.3; hot-dipped galvanized tubing.

2. Fittings and Conduit Bodies: NEMA FB 1; steel compression type.

D. Flexible Metal Conduit and Fittings:

1. Conduit: Galvanized steel strips, spirally wound.

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2. Fittings and Conduit Bodies: NEMA FB 1.

E. Liquidtight Flexible Conduit and Fittings:

1. Conduit: Flexible metal conduit with PVC jacket and integral grounding conductor.

2. Fittings and Conduit Bodies: NEMA FB 1; liquidtight, zinc coated steel.

F. Nonmetallic Conduit and Fittings:

1. Conduit: NEMA TC 2; Schedule 40 PVC.

2. Fittings and Conduit Bodies: NEMA TC 3.

Boxes:

References

A. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

B. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

C. NFPA 70 - National Electrical Code.

Outlet Boxes

A. Provide galvanized or cadmium-plated pressed steel outlet boxes suitable for the conditions of each outlet. Provide multi-gang outlets of single box design; sectional boxes will not be acceptable.

B. Provide deep type cast metal outlet boxes located in damp locations exposed to weather or exposed areas subject to damage, complete with gasketed cover and threaded hubs.

C. Provide outlet boxes of sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70, and not less than 1-1/2 inch deep unless shallower boxes are required by structural conditions and are especially approved by A/E.

D. Provide 4-inch octagonal ceiling outlet boxes.

Pull and Junction Boxes

A. Provide galvanized sheet metal boxes conforming to NEMA OS 1. Provide hinged enclosures for any box larger than 12 inches in any dimension.

B. Provide cast metal boxes for outdoor and wet locations conforming to NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight with cover and ground flange, neoprene gasket, and stainless steel cover screws.

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Wire and Cable:

References

A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

Building wire

A. Thermoplastic-Insulated Building Wire: NEMA WC 5.

B. Rubber-Insulated Building Wire: NEMA WC 3.

C. Feeders and Branch Circuits Larger Than No. 6 AWG: Copper, stranded conductor, 600 volt insulation, THW, THHN/THWN, XHHW, RHW, UNO.

D. Feeders and Branch Circuits No. 6 AWG and Smaller: Copper conductor, 600 volt insulation, THW, THHN/THWN; smaller than No. 8 AWG, solid conductor, UNO.

E. Control Circuits: Copper, stranded conductor 600 volt insulation, THW, THHN/THWN.Wiring types BX and MC will not be acceptable for use on this project.

Wiring Connections And Splices

A. Connect and splice wire No. 8 AWG and smaller with self-insulating, wire nut connectors.

B. Terminate and splice all No. 6 AWG and larger copper conductors, except for load side lugs on Class I and II switchboards, panelboards, motor control centers, fusible switches, circuit breakers, transformers and individual motor controllers with high conductivity, wrought copper, color-keyed compression connector similar to T & B Series 54100 for terminal connection; Series 54500 for two-way copper-to-copper splices; and Series 54700 for tapping and pigtailing copper conductors.

C. Set screw type connectors are only acceptable on the load side lugs of Class I and II switchboards, panelboards, circuit breakers, fusible switches and on individual motor controllers.

D. Where three or more conductors larger than No. 8 AWG are installed in wiring gutter, utilize a screw-type power distribution block. Utilize split-bolt mechanical connector, filled and taped for smooth joint, only where specifically requested by Contractor and approved by A/E.

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Grounding and Bonding Systems:

References

A. NECA - Standard of Installation.

B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NFPA 70 - National Electrical Code.

D. NECA NEIS 331 – Standard for Building and Service Entrance Grounding and Bonding

E. TIA J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

Materials

A. Wire:

1. Stranded, copper cable Foundation Electrodes: 2/0 AWG.

3. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

Automatic Transfer Switches:

References

A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:

1. UL 1008 – Transfer Switches

2. UL 991 - Tests for Safety-Related Controls Employing Solid-State Devices

3. NFPA 70 – National Electrical Code

4. NFPA 110 – Emergency and Standby Power Systems

5. NEMA ICS 10 – AC Transfer Switch Equipment

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6. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems

Quality Assurance

A. Regulatory Requirements:

1. Conform to applicable code for standby electrical systems.

2. Conform to UL 1008.

Automatic Transfer Switch

A. Configuration: Electrically-operated, mechanically-held transfer switch; dual-motor operated.

B. Double-throw with simple over-center type linkage so that both sets of contacts move simultaneously.

C. Positively interlock, mechanically and electrically, the normal and emergency contacts to prevent simultaneous closing. Mechanically lock the switches without the use of hooks, latches, springs or semi-permanent magnets.

D. Provide separate arcing contacts for all poles. Molded case circuit breakers or contactors will not be acceptable. Provide brush type main contacts of silver alloy protected by arc barriers and arc quenchers.

E. Equip transfer switch with permanently attached, safe, dead-front manual operator with same transfer speed as electrical operator to prevent flashovers.

F. Provide sturdily built operating mechanism of industrial type components which does not depend on critical electrical or mechanical adjustments. Use of miniature type limit switches and nonindustrial type components will not be acceptable.

G. Provide silver alloy contacts with a minimum rating of 10 amperes on all relays. Provide industrial type control that meet or exceed NEMA and IEEE standards and are field adjustable and have replaceable contacts.

H. Ratings:

1. Voltage: 120/240 volt, 1 phase, 3 wire+G, 60 hertz.

I. Automatic Sequence of Operation:

1. Initiate Transfer of Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

2. Monitor Before Transfer to Alternate Power Source: Frequency and voltage to be within acceptable limits.

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3. Monitor normal source of power by use of voltage sensitive relays in each switch. Adjust relays to detect failure when any phase or leg drops below 70 percent of normal voltage and sense restoration when all phases or legs have returned to at least 90 percent of normal voltage.

4. Provide close differential (90 percent dropout and 95 percent pickup) relays on connected load which will prevent transfer of load to emergency source upon a voltage frequency drop until it has reached at least 90 percent of rated voltage and frequency.

5. Provide a solid state timer to signal the generator to start after an adjustable time delay of 0.5 to 6 seconds. Provide lockout relay to prevent transfer until the generating set has reached 90 percent of voltage rating and frequency.

6. Time Delay Before Transfer to Emergency Power: Provide adjustable time delay of 0 to 60 seconds on transfer to emergency.

7. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

8. Time Delay Before Transfer to Normal Power: Provide an adjustable time delay on retransfer (0 to 25 minutes); factory set at 5 minutes, to assure a stable normal source before returning the load to the normal source. Include a bypass circuit switch to override time delay in the event of simultaneous failure of the emergency source and availability of a suitable normal source.

9. Time Delay on Retransfer: Provide an adjustable time delay between opening of emergency contacts and closing of normal contacts to allow motor loads to decay.

10. Time Delay on Engine Shutdown: Provide an adjustable time delay on retransfer to normal (0 to 5 minutes); factory set at 5 minutes.

J. Enclosure: Type 1.

Accessories

A. Indicating Lights: Mount in cover of enclosure to indicate normal source available, alternate source available, switch position.

B. Test Switch: Mount in cover of enclosure to simulate failure of normal source.

C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

D. Transfer Switch Auxiliary Contacts: One normally open; one normally closed.

E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 5 hertz from rated nominal value.

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F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 5 hertz from rated nominal voltage.

Panelboards:

References

A. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

B. UL 198E - Class R Fuses.

Spare Parts

A. Keys: Furnish two keys to Owner for each panelboard, all keyed alike.

General

A. Conform to UL standards and bear UL label. Form cabinets from code gage galvanized steel. Form fronts of code gage cold rolled steel bonderized after fabrication.

B. Provide cabinet fronts with concealed hinges, concealed adjustment means and master keyed flush lock. Finish front in manufacturer's standard gray enamel.

C. Provide with main lugs and breakers or fuses as scheduled on the drawings. Provide main lug connection to accommodate T & B compression connector on end of cable. Attach connector to panel bus with two bolts per lug. Provide captive type bolts or studs to facilitate reinstallation of the lugs with the wire attached.

D. Provide all panelboards with copper bus of the ratings scheduled and designed for all indicated devices and spaces, complete with taps and trim.

E. Minimum integrated short circuit rating 10,000 amps RMS symmetrical for 240 volt panelboards; 14,000 amperes RMS symmetrical for 480 volt panelboards or as shown on the drawings. Integrated ratings may be based on tested series ratings in conjunction with feeder breaker actually used.

F. Size bus bars to limit the temperature rise within the panelboard to 50 degrees C over a 40 degrees C ambient temperature.

G. Provide adequate space and provisions for wire No. 6 AWG and larger conductors to terminate with compression type connector to main lugs.

Distribution Panelboards

A. Enclosure: Type 1, unless scheduled otherwise.

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B. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled.

Branch Circuit Panelboards

A. Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.

B. Enclosure: Type 1; unless indicated otherwise.

C. Provide insulated neutral bus and separate copper grounding bus bonded to enclosure.

D. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled.

E. Sequence phase all adjacent breakers. All circuit breaker connection straps shall be rated at 100 amperes minimum.

METHOD OF MEASUREMENT

Payment will be a lump sum basis. Once the Node Building Shelter is designed and delivered, 80% of the lump sum price will be paid. The final 20% of the lump sum price will be paid after the Node Building Shelter has been installed, tested, electrical system installed, and the Node Building Shelter with all components is considered operational. Payment will be full compensation for all labor, testing, materials and equipment required to complete the work.

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TRAFFIC MANAGEMENT SYSTEM BUILDING EQUIPMENT

Section 614 of the Standard Specifications is hereby revised to include the following:

DESCRIPTION

This work consists of the following:

(1) Furnish and install freestanding equipment racks and associated accessories.

(2) Furnish and install an access control system and associated accessories.

(3) Furnish and install an Environmental Monitoring System and associated accessories.

(4) Uninterruptible Power Supply (UPS).

MATERIALS

7- Equipment Racks – Provide freestanding equipment racks to store computer, data storage, networking equipment, and SCADA equipment within the TMS Building. Each rack enclosure shall have a rectangular frame without a top panel, side panels and doors. Installed racks shall include power and cable management accessories that keep network and power cables separate and organized.

The rack frame shall be rectangular with four corner posts, manufactured from aluminum with bolted frame construction. The sides of the frame shall have three supports located near the top, middle and bottom to allow attachment of equipment mounting rails and thermal, cable and power management accessories. The rack frame shall have a static load limit of 2000 lb.

The rack shall not exceed 28” in width (overall), 34” in depth, and 76” in height.

Each rack shall include two pairs of equipment mounting rails. Mounting rails shall bolt to the supports located near the top, middle and bottom of the frame and shall be fully adjustable in depth to provide front and rear support for equipment. Equipment mounting rails shall be spaced horizontally to support 19” wide EIA/ECA-310 compliant rack-mount equipment and shall provide up to 36” of rail-to-rail depth for equipment. Mounting rails will be L-shaped. The front flange shall be #12-24 threaded according to the EIA/ECA-310 universal hole pattern with equipment mounting holes on alternating 0.625” – 0.625” – 0.5“ vertical hole centers. Rack mount spaces or units (U) shall be 1.75” high and shall be marked and numbered on the mounting rails. Numbering shall start at the bottom of the rail. Mounting rails shall provide 45 U for equipment.

The rack frame shall assemble with hardware provided by the rack manufacturer.

The rack shall be UL Listed as a Communications Circuit Accessory to standard UL 1863 under category DUXR. UL Listing must be stated in the manufacturer’s product literature.

The rack shall include (4) leveling feet, (4) clamps for securing the leveling feet to the floor, and a means for bonding the rack to the Telecommunications Grounding Busbar (TGB).

Each installed rack shall be equipped with two vertical cable managers to store network cables. The vertical cable manager shall attach to the outer side of the rack frame and shall be adjustable in depth to

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match equipment requirements. The vertical cable manager shall have individual C-shaped plastic cable rings. The rings shall be able to align with the side or the front/rear of the rack.

Seven racks, each of which shall be equipped with two vertical mount (zero U) Power Distribution Units (PDUs), including vertical PDU mounting brackets, as required. The PDUs shall be designed in accordance with the applicable sections of UL 60950-1 (December 19, 2011): *Information Technology Equipment – Safety*. PDUs shall be rated for 30A of integral branch overload protection, with 120V input and output. Single phase input power shall be provided via a minimum 10 foot power cord with appropriate locking input plug connection. PDUs shall be equipped with 27 NEMA 5-20R power outlets. PDUs shall be equipped with upgradable network communications to support remote monitoring and/or control capabilities. PDUs shall provide local and remote monitoring of individual PDU volts, amps, watts, and kilowatt-hours and provide user positioned LCD status display for local monitoring. Vertical mount dimensions shall not exceed 69 inches (H) x 2 inches (W) x 4 inches (D). The PDUs shall be rated for operation at ambient temperatures of 32°F to 131°F for altitudes 10,000 feet above sea level with a relative humidity of 0% to 95%, non-condensing and non-corrosive. Each PDU shall include a user's manual that contains installation drawings and instructions, a functional description of the equipment, safety precautions, illustrations, and operating procedures. The manufacturer shall warrant each PDU against defects in materials and workmanship for a minimum period of two (2) years. Before shipment, the manufacturer shall fully and completely test each PDU to assure compliance with the specification. The manufacturer shall submit certified test reports showing the results of the factory testing that shall be included in each shipping box containing a PDU.

One universal cabinet light shall be furnished and installed at the top, rear of each new rack provided under this Contract. The universal cabinet light shall be EIA/ECA-310 compliant for 19" racks and not exceed 1 RU in height. It shall be mounted with the light source facing into the rack to direct illumination downward. The light source shall be fluorescent and not exceed 8 W of power consumption from a 115 VAC source. A lens shall be provided to protect the light source from accidental contact and must be either clear or white. Each universal cabinet light shall include an on/off switch and a minimum 6' power cord.

Each installed rack shall be equipped with shelves for equipment that does not rack-mount directly to the equipment mounting rails as stated herein. Rack shelves shall be fixed with a vented mounting surface. Rack shelves shall be sized to fit the rack-mount width and depth of the rack and shall have adjustable depth mounting brackets that allow attachment to the front and rear pair of equipment mounting rails within the rack. Rack shelves shall be wider and deeper than the equipment placed on the shelf and shall have a load bearing capacity that exceeds the fully populated weight of equipment. Equipment shall be secured to the shelf with a bracket.

Provide additional equipment mounting hardware to attach equipment to the equipment mounting rails in the rack.

Access Control System –

The proposed access control system for this facility shall be interoperable with existing CDOT employee badges. A minimum of one door controller shall be provided. The control panel shall utilize one (1) proximity reader (short read range). A surface mounted box shall be provided for housing the proximity reader. The Access Control System shall be compatible with existing CDOT access control systems.

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The new card access systems via existing network equipment to the main Velocity control software at the Colorado Traffic Management Center in Golden. Interaction with on-site personnel and access to these sites shall be coordinated through the Engineer.

The Contractor shall submit product information to Engineer for Approval.

MATERIALS

CDOT currently uses the Hirsch Identive access control system at numerous locations statewide. Accordingly, the access control system that is provided for these node locations shall be interoperable with existing CDOT employee badges.

The controller shall be the Hirsch Identive Model M1N one (1) door controller with integrated Secure Network Interface Board (SNIB).

The control panel shall utilize (1) Hirsch Identive Model CR20L-BL HID proximity reader (short read range of 3.75 inches).

Hirsch Identive Model MB2 surface mounting boxes shall be provided for housing the proximity reader.

The locking mechanism shall utilize magnetic locks with a minimum resistance of 500 pounds. The fails safe mode shall be open. An internal push bar shall be installed on the door to allow for egress at all times.

The building equipment shall include the following:

(1) Hirsch M1N Model 1 single door controller

(2) Hirsch LIF-D1SP Ethernet to serial device server

(3) Hirsch MRIA match reader interface assembly

(4) Hirsch MB2 surface mount back box for MRIA

(5) Hirsch CR20L-BL pox point reader

(6) Hirsch MELM2 end of line module

(7) Altronix AL125ULX lock power supply

(8) 12 volt 5 amp hour SLA batteries

(9) GE / Sentrol 1078C recessed door contact

(10) Command Access CL93DEU REX electrified Best 9K lock with rex switch

(11) RCI 9508-12S armored door transfer loop

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(12) Small Format Interchangeable Core (SFIC) core keyway for electric lockset

(13) Cable, connectors and miscellaneous hardware

The Contractor is required to submit cut sheet submittals for all items included in this work for approval by the Project Engineer prior to installation.

The work shall include the following elements:

(1) Provide and install M1N controller and lock power supply inside the Node Building on wall near entry door.

(2) Connect 120vac power to the M1N controller and lock power supply. Provide and install surface mounted conduit from the M1N panel to the reader, electric lock and network rack.

(3) Provide and install MRIA, card reader, door contact and electric lock set with rex switch on door.

(4) Provide and install cabling to devices on door from M1N panel. Terminate cabling to devices and M1N panel.

(5) Provide and install Cat5e cabling from M1N panel to network rack.

(6) Program new panel and door into existing Velocity software.

(7) Install final connections to the main control equipment for the above referenced systems.

CONSTRUCTION REQUIREMENTS

The Contractor shall submit requests to the Engineer to store cable and equipment on site. These requests will be reviewed and approved by the Engineer on a site-by-site basis.

The Contractor is required to provide cabling diagrams showing the connectivity of all equipment that is to be installed as part of this item. These diagrams shall be provided prior to any cabling work for final approval by the Project Engineer.

CDOT will make all connections to the existing Ethernet equipment, but this equipment shall be included in the cabling diagram as it pertains to device connection.

The Contractor shall notify the Engineer a minimum of 48 hours in advance of any work that is to be performed in the Node Building. The static IP address for any given node will be provided by CDOT. The Contractor shall notify the Engineer a minimum of 48 hours in advance regarding requests for this information.

The Contractor shall bring the panel online and test for proper operation. The Contractor shall conduct final testing and inspection for the above referenced systems. Instruction shall be provided that will help

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enable members of the CDOT Intelligent Transportation Systems (ITS) Branch to create and maintain access for all applicable card holders that require access to a given node. Instruction shall also be provided that will help enable members of the ITS Branch to monitor the on-going access that is occurring at a given node.

The Contractor shall provide a 5 year extended warranty on all equipment that shall provide coverage on all equipment for 5 years from the date of installation and include protection against lightening and electrical surges. Coverage for repair or replacement of equipment shall be provided. The batteries shall be warrantied for 1 year.

Mechanical Systems (Environmental Monitoring System) –

For this project, the Mechanical Systems item shall be for the provision and installation of an Environmental Monitoring System for node locations, as specified in the plans.

The Environmental Monitoring System shall also have a backup wireless communication system that will allow for continued monitoring if the primary communication system fails. A wireless cellular data modem, associated power supply, cellular antenna, antenna cable, communication cable, and any necessary mounting hardware shall be furnished and installed by the Contractor.

Interaction with on-site personnel and access to these sites shall be coordinated through the Engineer.

The Contractor is required to submit cut sheet submittals for all items included in this work for approval by the Project Engineer prior to installation.

MATERIALS

The Mechanical Systems equipment shall include the following:

(1) Large enterprise environment monitoring system

(2) External AC power, voltage, frequency, and current monitor

(3) External temperature / humidity sensor

(4) External smoke detection sensor

(5) External spot liquid detection with SPDT contacts

The Environmental Monitoring System shall satisfy the following criteria:

(1) The system shall include three internal sensors: temperature, humidity and power. It shall also supports 16 external configurable sensors, eight digital input sensors, and four output relays for control of external devices.

(2) Sensors shall be hot pluggable.

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(3) Shall be able to monitor (ping) up to 64 IP network devices – alerts are sent if devices are not responding.

(4) Sensor conditions (events) shall be configurable to trigger alerts by themselves, and / or be used in combination with other events to trigger Smart Alerts.

(5) Redundant dual power connection.

(6) Includes internal battery backup

(7) Includes USB ports for connecting USB modem, for downloading log data to USB flash drive, or for connecting a USB LCD screen.

(8) Supports IP network video cameras for live view of any facility.

(9) The capability to trigger a snapshot from an IP camera after any programmed event.

(10) Includes a server based management software for monitoring and control of the remote system and sensors.

The Environmental Monitoring System shall also meet the following requirements:

(1) Report temperatures from 32 to 104°F (0 to 40°C)

(2) Report humidity from 20 to 80% relative humidity at temperatures between 32 to 104°F (0 to 40°C)

(3) Measure main voltage: 0 to 255 VAC / Measure battery voltage: 0 to 20 VDC

(4) Ethernet Port shall be a 10/100 Base-T Ethernet port with RJ45 Ethernet connector

(5) Alerts can be provided by a minimum of four methods:

a) Email Authenticates

b) Web Interface

c) SNMP network management (V1/V2c/V3)

d) Front Panel LEDs for internal and external sensors, backup battery, data log, power, AUX power

(6) The system can be accessed by a minimum of five methods:

a) Web Interface

b) Telnet

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c) SSH

d) Network Operation (SNMP) V1/V2c/V3

e) RS232 (via female RJ45 RS232 connector & female USB Type B connector)

(7) Shall support these protocols; HTTP/HTTPS, SNMP V1/V2c/V3, SMTP, TCP/IP, Syslog, SNTP, DHCP, SSHv2, SSLv3, LDAPv3, AES 256-bit, 3DES, Blowfish, RSA, EDH-RSA, Arcfour, IPV6, WAP 2.0

(8) Shall have an operating temperature range of 32 to 100°F (0 to 38°C)

(9) Shall be mountable in standard 19" rack.

The cellular wireless data modem shall be a standalone hardened unit designed to communicate to serial and Ethernet devices over 4G LTE and 3G wireless network. The modem shall consist of a unit capable of transmitting data by its embedded operating system and its own TCP / IP stack to enable transmission of data from non-IP devices. The modem shall be capable of active/standby configuration for use as failover communication link for out of band management to network infrastructure. The modem shall meet the following minimum requirements:

(1) Communication to Ethernet devices with a minimum of 1 x 10/100 RJ-45 Ethernet jacks.

(2) Wireless Communications utilizing 802.11 b/g/n for connection with up to 32 devices at a time with WEP, WPA, WPA2, and AES encryption.

(3) Support TCP/IP, UDP/IP, DHCP, HTTP, SNMP, SMTP, FTP, DMZ, PPPoE passthrough, DNS, DDNS, LAN/WAN affinity, VPN, VLAN support, MAC filtering, port forwarding, routing, and GPS protocols.

(4) Visual light indicators that show unit status for power, cellular signal, network connection, and data activity.

(5) Cellular network support for LTE at 700MHz and CDMA EV-DO rev A, 1x EV-DO rev 0, or 1xRTT at 800/1900 MHz with options for MIMO in LTE mode or receive diversity in CDMA mode.

(6) Remotely upgradeable PRL, firmware, and configuration.

(7) 4G cellular wireless with backwards compatibility to EV-DO rev A, A/O, CDMA 1x.

(8) Built in GPS receiver with port for external antenna.

(9) 50 ohm SMA antenna interfaces.

(10) Operate on 9-18 VDC at 1.5 amps or less.

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(11) Operate within a temperature range of -30 to 70˚C -4 to 122˚F at 10 to 85% humidity.

The power supply shall output a nominal 12 volts direct current at a minimum of 2 amps to power the wireless cellular data modem. The power supply shall be rated to operate within a temperature range of -10 to 130˚F.

The cellular antenna shall be outdoor rated, omnidirectional, and capable of transmitting and receiving on at least 3 frequency bands: 700MHz for LTE and 800/1900 MHz with a minimum 3dBi gain. The antenna shall be have an NMO mountable base that can be used for wall mounting.

The antenna cable shall be an RG-58 coaxial cable type rated at 50 ohms. The cable shall be terminated with a male SMA on one end for connection with the wireless cellular data modem. The other end shall be terminated with the correct connector to interface with the tri band antenna.

The communication cable shall be constructed from twisted pair cable with minimum 22 gauge stranded conductors. For Ethernet communication the cable shall be terminated with 8P8C connectors with T568B pin/pair assignments.

A 19” rack mountable shelf shall be included for installation of the modem

CONSTRUCTION REQUIREMENTS

The environmental monitoring system shall be installed in a 19” rack as shown on the Plans or directed by the project Engineer. The liquid detection sensor shall be installed on the low point of the floor. In buildings with raised floor this will be underneath the raised floor. The temperature and humidity sensor shall be installed on the high point of the rack that the monitoring system is installed. The smoke detection sensor shall be installed in the ceiling in middle of the room.

The wireless cellular data modem shall be installed below the environmental monitor in a rack mountable shelf. The cellular antenna shall be mounted on the exterior of node buildings to get the best possible receive signal. Any cable penetrations made in the building shall be watertight and cable runs shall include drip loops to eliminate any moisture ingress into the building. A complete installation consists of the wireless cellular data modem, power supply, dual band antenna, antenna cable, communication cable, and wiring power to the unit. The Contractor shall install the power supply to the wireless cellular modem per manufactures recommendations. The contractor shall connect the wireless cellular modem end equipment as specified in the Plans or directed by the project Engineer. The placement of the unit shall allow provision for cable installation and maintenance as indicated on the Project Detail Sheet and manufacturer’s recommendations. All electrical wiring and connections shall meet NEC standards. The contractor is responsible for supplying all necessary cabling, connectors, and hardware for a fully functional installation.

The Contractor shall notify the Engineer a minimum of 48 hours in advance of any work that is to be performed in the Node Building.

The Contractor shall bring the system online and test for proper operation. The Contractor shall conduct final testing and inspection for the above referenced systems. Instruction shall be provided that will help enable members of the CDOT Intelligent Transportation Systems (ITS) Branch to configure the system.

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The Contractor shall provide a 2 year warranty on all equipment and labor that includes protection against lightening and electrical surges. Coverage for repair or replacement of equipment shall be provided.

Provision and installation of the backup wireless communication system will not be measured and paid for separately, but shall be part of the Mechanical Systems item. It shall include a warranty, testing, documentation, all necessary wiring, RF antenna, communication cables, labor and other items necessary to complete the work.

Uninterruptible Power Supply

Standards

The UPS is designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

UL Standard 1778
IEEE C62.41, Category A & B
CSA 22.2, No. 107.1
FCC Part 15, Sub Part B, Class A
National Electrical Code (NFPA 70)
IEC 62040-3 (formerly NEMA PE-l)

Modes of Operation

The UPS shall operate as a true on-line system:

A. Normal - The critical AC load is continuously supplied by the UPS inverter. The input converter derives power from a utility AC source and supplies DC power to the inverter. The battery charger maintains a float-charge on the battery.

B. Back-up - Upon failure of utility AC power the critical AC load is supplied by the inverter. In this mode the inverter is powered from the battery. There is no interruption in power to the critical load upon failure or restoration of the utility AC source.

C. Recharge - Upon restoration of utility AC power, the input converter will automatically restart and resume supplying power to the inverter. The battery charger will resume recharge of the battery.

D. Automatic Restart - After a utility AC power outage and complete battery discharge, the UPS will automatically restart and resume supplying power to the critical load. In addition, the battery charger will automatically recharge the battery. This feature is enabled (factory default) and will be capable of being disabled by the user. The user will also be able to program two auto restart delay settings

1. Battery capacity % level

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2. Countdown timer

E. Bypass - The bypass will provide an alternate path for power to the critical load and is capable of operating in the following manner:

1. Automatic - In the event of an internal failure or should the inverter overload capacity be exceeded, the UPS will perform an automatic transfer of the critical AC load from the inverter to the bypass source.

2. Manual - Should the UPS need to be taken out of service for limited maintenance or repair, manual activation of the bypass will cause an immediate transfer of the critical AC load from the inverter to the bypass source. The input converter, inverter, and battery charging operations will continue to operate, provided the control enable switch is in the "On" position.

Performance Requirements

System

A. Configuration: UPS systems are configured or upgradeable to power ratings as follows:

12 Bay Frame Systems only

4 kVA system to 8, 12, 16, or 20kVA redundant system.

8 kVA system to 12, 16, or 20kVA redundant system.

12 kVA system to 16, or 20kVA redundant system.

B. Isolation: Input to output isolation is provided via the output transformer, regardless of the operating mode. (UPS or bypass)

C. Remote Stop: The UPS provides provisions for remote stop (Emergency Power Off) capability.

AC Input to UPS

A. Voltage Configuration: 208 or 240 VAC nominal (tap selectable), single-phase, 2-wire-plus-ground. The operating voltage range is variable based upon output loading percentages as follows:

% UPS Load	Input Voltage
80 – 100%	170 VAC
60 – 80%	144 VAC
30 – 60%	127 VAC
0 – 30%	110 VAC

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B. Frequency: 40 to 70 Hz.

C. Input Current Distortion: 5% THD maximum at full load.

D. Input Power Factor: 0.98 lagging at 100% rated load.

E. Inrush Current: 150% of full load input current maximum for 3 cycles.

F. Surge Protection: Sustains input surges without damage per criteria listed in IEEE C62.41, Category B.

AC Output

A. Voltage Configuration: 120/240-VAC, single-phase, 3 wire-plus-ground.

B. Voltage Regulation: +/- 3% steady state.

C. Frequency Regulation: 60 Hz, +/- 0.5%.

D. Frequency Slew Rate: field selectable from 0.5 to 5.0 Hz maximum per second.

E. Bypass Frequency Synchronization Range: field selectable from 0.5 to 5.0 Hz maximum per second.

F. Voltage Distortion: 3% total harmonic distortion (THD) maximum into a 100% linear load, 7% THD maximum into a 100% non-linear load with crest factor ratio of 3:1.

G. Load Power Factor Range: 0.5 lagging to 1.

H. Output Power Rating: Rated kVA at: 0.7 lagging power factor.

I. Overload Capability: >100% - 110% indefinitely, 111% -150% for 10 seconds, 151% - 200% for 0.25 seconds. The load will be transferred to bypass when any of the above conditions are exceeded. >201% for min. 2 cycles, then shut down of UPS. Immediate shutdown into a short circuit.

J. Voltage Transient Response: +/- 7% maximum for any load step up to and including 100% of the UPS rating.

K. Transient Recovery Time: To within 1% of steady state output voltage within 96 milliseconds.

Batteries

A. Internal Battery: The battery consists of flame retardant, valve regulated, lead acid cells. The UPS is suitable for installation inside a computer room per requirements of UL Standard 1778.

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B. Reserve Time: The UPS contains internal battery system to provide a reserve time of 7 minutes at 100% load with an equal number of power and battery modules fitted. The UPS includes provisions to fit additional battery modules internally if space permits. The UPS also interfaces with an external battery cabinet to extend reserve time capabilities.

C. Battery Recharge: To prolong battery life, the UPS includes temperature-compensated battery charging. When equal number of power modules and battery modules are fitted the battery charger is able to recharge the internal batteries to 90% charge in six hours at nominal input voltage and nominal ambient temperature.

Environmental Conditions

A. Ambient Temperature

Operating: UPS 0° C to +40° C; battery 20° C to 25° C for optimum performance.

Storage: UPS –20° C to +60° C; battery –20° C to 25° C for maximum 6 months.

B. Relative Humidity

Operating: 5 to 95% non-condensing.

Storage: 5 to 95% non-condensing.

C. Altitude

Operating: To 10,000 feet. Derating/reduced operating temperature range required for higher altitudes.

Storage: To 30,000 feet.

D. Audible Noise

Noise generated by the UPS during normal operation does not exceed 62 dBA measured at three feet (one meter) from the surface of the UPS.

E. Electrostatic Discharge

The UPS is able to withstand a minimum 15 kV without damage and will not affect the critical load.

User Documentation

The specified UPS system is supplied with one (1) user's manual. Manuals include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step by step operating procedures, and routine maintenance guidelines.

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Warranty

The UPS manufacturer warrants the UPS against defects in materials and workmanship for two (2) years. The warranty covers all parts for two (2) years and onsite labor for ninety (90) days. With start-up provided by manufacturer, the warranty covers all parts and onsite labor for two (2) years.

Quality Assurance

Manufacturer Qualifications

A minimum of thirty years' experience in the design, manufacture, and testing of solid-state UPS systems is required.

Factory Testing

Before shipment, the manufacturer fully and completely tests the system to assure compliance with the specification. These tests include operational discharge and recharge tests on the internal battery to guarantee rated performance. The UPS ships completely assembled and all modules installed. The manufacturer shall submit certified test reports showing the results of the factory testing for acceptance to be included with each shipping unit.

Fabrication

All materials and components making up the UPS will be new, of current manufacture, and not in prior service except as required during factory testing. The UPS is constructed of replaceable subassemblies. All active electronic devices are solid-state.

A. Wiring

Wiring practices, materials, and coding will be in accordance with the requirements of the National Electrical Code (NFPA 70) and other applicable codes and standards.

B. Cabinet

The UPS unit is comprised of: power module, battery module, control module, and user interface module housed in a single free-standing enclosure and meets the requirements of IP20. The UPS system is designed such that the battery modules may be installed into any module bay in the cabinet and power modules into any module bay in the top half of the cabinet. The UPS cabinet is cleaned, primed, and painted with the manufacturer's standard color. Casters and leveling feet are provided. 12 bay cabinet dimension is 20 inches wide, 28 inches deep, and 53 inches high.

Cooling

The UPS is cooled by forced air via internally mounted fans.

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Components

Input Converter

A. General

Incoming AC power is converted to a regulated DC output by the input converter for supplying DC power to the inverter. The input converter provides input power factor and input current distortion correction.

B. AC Input Current Limit

The input converter is provided with AC input over current protection.

C. Input Protection

The UPS has built-in protection against undervoltage, overcurrent, and overvoltage conditions including low-energy surges introduced on the primary AC source and the bypass source. The UPS can sustain input surges without damage per criteria listed in IEEE C62.41, Category A & B. The UPS cabinet contains an input breaker sized to supply full 20kVA rated load and to recharge the battery at the same time.

D. Battery Recharge

To prolong battery life, the UPS contains temperature-compensated battery charging. When an equal number of power modules and battery modules are installed the battery charger is able to recharge the internal batteries to 90% charge in six hours at nominal input voltage and nominal ambient temperature.

E. Charger Output Filter

The battery charger is a DC power supply to minimize ripple current into the battery.

Inverter

A. General

The inverter converts DC power from the input converter output, or the battery, into precise regulated sine wave AC power for supporting the critical AC load.

B. Overload

The inverter is capable of supplying current and voltage for overloads exceeding 100% and up to 200% of full load current. A visual indicator and audible alarm indicates overload operation. For greater currents or longer time duration, the inverter has electronic current- limiting protection to prevent damage to components. The inverter is self-protecting against any magnitude of connected output overload. Inverter control logic senses and disconnects the inverter from the critical AC load

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without the requirement to clear protective fuses. The load will be transferred to bypass when any of the above conditions are exceeded

C. Maximum Load Alarm

The user can set the alarm point to a value less than 100% rating such that the UPS will alarm before an overload condition or loss of redundancy is reached.

D. Output Frequency

The output frequency of the inverter is controlled by an oscillator. The oscillator will hold the inverter output frequency to +/- 0.5% for steady state and transient conditions. The inverter tracks the bypass continuously, providing the bypass source maintains a frequency within the user-selected synchronization range. If the bypass source fails to remain within the selected range, the inverter will revert to the internal oscillator.

E. Output Protection

The UPS inverter employs electronic current limiting.

F. Battery over Discharge Protection

To prevent battery damage from over discharging, the UPS control logic controls the shutdown voltage set point. This point is dependent on the rate of discharge.

Display and Controls

A. General

The front panel will consist of multiple status LEDs, switches, and a four line by twenty character LCD display for additional alarm/configuration information. All mimic display LED's are green in color and indicate the following:

AC Input
On Battery
Load On/Off
On Inverter
On Bypass

The UPS fault indicator is used with additional indicators and audible alarms to notify the user that a UPS fault condition has occurred. The color of the fault indicator LED is amber.

Replace Battery Module
Replace Power Module
Replace Control Module

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On Bypass
Low Battery
OverTemp Warning
UPS Shutdown

If there is a fault condition, the UPS will attempt to maintain conditioned power to the load, or at minimum transfer to bypass. There will also be a visual indication on each module should the module fail and need to be replaced.

In addition to an audible/visual fault signal the UPS also records fault occurrences in a rolling event log. The event log on the standard unit can record up to 255 occurrences, with the oldest events discarded first, etc. The user has access to the event log through the LCD display. Every alarm and/or event recorded in the event log will contain a time and date stamp.

B. Audible Alarms

The volume of all audible alarms is at least 65dBA at a distance of three feet (one meter). An audible alarm is used in conjunction with the LED/LCD indication to indicate a change in UPS status.

The audible alarms enunciate for utility line loss, low battery (while on battery), and all other alarm conditions. For all alarm conditions, the user must look at the display to determine the cause of error/alarm.

All alarm tones are a continual tone until the condition rectifies itself or the alarm is silenced. Once silenced, the audible alarm will not sound until a new alarm condition is present.

C. Alarm Silence Button

In addition to the load On/Off switch, the user interface includes an audible ‘Alarm Silence’ switch. If the alarm silence switch is pressed for one second, all current audible alarms will be disabled. If a new alarm occurs, or a cancelled alarm condition disappears and then re-appears, the audible alarm is re-enabled.

D. LCD Display

The LCD display is used to provide information to the user. The display is used to program ALL information (voltage, frequency, etc.) into the UPS. Any display values that require time/date will be ‘year 2000’ compliant.

Automatic Battery Test

The UPS will initiate an automatic battery testing sequence periodically, at a programmed day and time of day, selectable by the end user. The user will be able to select the interval of the battery test and will be able to select 1, 2, 3, 4, or 6 week intervals, or can select to disable the automatic battery test.

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Should a battery failure occur, the battery module will disconnect itself from the critical DC bus and the UPS will immediately return to normal mode and fault signals (visual, audible, and remote via serial) will be communicated. No audible or remote (via serial/contact closures) indication of the battery test is communicated during the duration of the automatic battery test.

The automatic battery test factory default settings are enabled at a two week interval and to occur on Wednesdays at 0600hours (based on the twenty-four hour clock).

Remote Emergency Power Off (REPO)

The remote emergency power off function (REPO) allows the user to disable all UPS outputs in an emergency situation. The REPO, in order to be flexible, will be able to interface with either normally open (N.O.) or normally closed (N.C.) systems. The REPO is activated when a pair of 'SELV' contacts, external to the UPS, are activated. The REPO connection is through a simple terminal block type connector.

The REPO function will not operate if no system control modules are present in the UPS or if the manual bypass switch is in the bypass position. The user must supply a means of interfacing with the REPO circuit to allow disconnecting the UPS input feeder breaker to remove all sources of power to the UPS and the connected equipment to comply with local wiring codes/regulations.

Regardless of the UPS mode of operation when the REPO is activated, the UPS output will not be re-enabled until the following occurs:

- REPO contacts are reset (closed if N.C. contacts are used and open if N.O. contacts are used)
- Input circuit breaker is closed
- Control enable switch is turned on
- User interface on/off switch is depressed

Bypass

A. General

A bypass circuit is provided as an integral part of the UPS. The bypass has an overload rating of 300% rated full load for 10 cycles and 1000% for sub-cycle fault clearing. The bypass control logic contains an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit provides a transfer of the load to the bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS.

B. Automatic Transfers

The transfer control logic automatically activates the bypass, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:

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Inverter overload capacity exceeded

Inverter over temperature

UPS fault condition

For inverter overload conditions, the transfer control logic inhibits an automatic transfer of the critical load to the bypass source if one of the following conditions exists:

Inverter/Bypass voltage difference exceeding preset limits (±15 % of nominal)

Bypass frequency out of preset limits (± 5 % of nominal frequency)

C. Automatic Retransfer

Retransfer of the critical AC load from the bypass source to the inverter output is automatically initiated unless inhibited by the manual control. The transfer control logic inhibits an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

Bypass out-of-synchronization range with inverter output

Overload condition exists in excess of the inverter full load rating

UPS fault condition present

D. Manual Transfer

In addition to the internal bypass function, the UPS has a manual bypass function. The manual bypass function is provided via of a switch mounted on the bottom-front of the UPS, removal of the lower front bezel is required. The actual AC break time between inverter and bypass is less than four milliseconds.

The manual bypass provides a partial ‘wrap-around’ bypass, and is configured to wrap around the rectifier, battery charger, inverter, and battery in the same manner as the automatic bypass. The manual bypass does not wrap around the EMI filtering, overcurrent protection or isolation transformer.

The UPS will initiate an audible alarm upon transfer to manual bypass. The audible alarm is capable of being silenced by the user. The alarm will continue to sound (unless silenced) while in bypass mode. This shall provide a reminder to the user that the load continues to be powered from utility supply alone.

Internal Battery

Flame retardant, valve regulated, gas recombination, lead acid batteries shall be used as a stored-energy source for the specified UPS system. The battery is housed in separate replaceable modules

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that slide into any open bay of the UPS cabinet, and are sized to support the inverter at rated load and power factor, in an ambient temperature between 20° and 25° C, for a 7 minutes reserve time. The expected life of the battery is 3 to 5 years or a minimum 250 complete discharge cycles. For extended battery reserve time, additional battery modules may be added if the frame size allows; external battery cabinets are available as an option.

Communications

The UPS allows for flexibility in communications via (2) DB9 communication ports and (4) Intellislot ports on the rear of the UPS. The UPS is able to communicate through two communications ports simultaneously; the media of either communications port may change without affecting the operation of the UPS.

Network Communications

The user has the option of installing an optional Intellislot card to provide HTTP supported SNMP communication over a local area network. This card supports 10/100Mbit Ethernet over unsheilded twisted pair connection.

CONSTRUCTION REQUIREMENTS

All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Owner or Owner's representative. Equipment and materials shall be of the quality and manufacture indicated.

Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.

Material and work specified herein shall comply with the applicable requirements of:

(1) TIA-568-C: *Commercial Building Telecommunications Cabling Standard*, 2010

(2) EIA/TIA-569-B: *Commercial Building Standard for Telecommunications Pathways and Spaces*, 2004

(3) TIA-606-A *Administration Standard for the Commercial Telecommunications Infrastructure*, 2008

(4) TIA-J-STD-607-A: *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*, 2002

(5) TIA-942: *Telecommunications Infrastructure Standard for Data Centers*, 2010

Provide product data for the following: Manufacturers data sheets/cut sheets, specifications and installation instructions for all products (submit with bid).

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TRAFFIC MANAGEMENT SYSTEM BUILDING EQUIPMENT

Contractor shall provide all components of the rack system (rack, mounting rails, shelves, and cable managers) from a single manufacturer.

The Contractor shall use a level to verify that the rack is level in both the front-to-back direction and the side-to-side direction.

Contractor shall install and adjust to position all accessories including vertical cable managers, vertical PDUs, equipment-mounting rails, etc. using the manufacturer's installation instructions. Shelves, horizontal cable managers and filler panels, if used, may be installed after the rack is placed.

Racks shall be securely bonded to the TGB. Attach a bonding conductor sized as defined in TIA-J-STD-607-A and as defined by local code or the Owner between the Telecommunications Grounding Busbar and the rack. Attach the bonding conductor to the rack using included hardware according to the manufacturer's installation instructions. The Contractor shall provide the bonding conductor and other necessary hardware required to make the connections between the rack and the TGB.

Wiring Connections And Terminations

A. Make taps and splices in accessible junction or outlet boxes only.

B. Thoroughly clean wires before installing lugs and connectors.

C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

D. Provide joints in branch circuits only where such circuits divide. Where circuits divide, provide one through circuit to which the branch is spliced from the circuit. Do not leave joints in branch circuits for fixture hanger to make. Make all taps and splices with approved type compression connector.

E. Terminate spare conductors with electrical tape.

F. Identify and label all conductor terminations as specified in electrical identification.

G. Properly terminate indicated conductors in equipment furnished and provide properly sized lugs.

Color Coding

A. Color code distribution systems as follows:

1. 120/240V System:

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TRAFFIC MANAGEMENT SYSTEM BUILDING EQUIPMENT

Phase	Color
A	Black
B	Red
C	Blue
N	White
G	Green

2. For areas where local authority color coding differs from that specified, contact A/E for instructions.

B. Provide color coding throughout the full length of all wire No. 6 and smaller. Identification by permanent paint bands or tags at the outlets will be acceptable for wire sizes larger than No. 6. Provide the same color and shade of color throughout the project.

C. Provide additional self-adhesive labels that denote circuits that originate from the UPS panels with "UPS" and the panel and circuit number.

Equipment Labeling

Equipment labeling shall be provided for each generator, UPS, and PDU and must possess all critical information concerning the system to which it is affixed. This information shall include the following:

Equipment nomenclature and designation (e.g., UPS 1)

System capacity rating in kVA and kW (e.g., 20 kVA / 18 kW)

Input voltage, phasing, and connection (e.g., 480 V, 3-Phase, 3-Wire Input)

Output voltage, phasing, and connection (e.g., 480 V, 3-Phase, 3-Wire Output)

Frequency and power factor (e.g., 60 Hz, 0.9 PF Lagging)

System or switchboard serving this piece of equipment

System, switchboard, or load that is being served by this equipment

Field Quality Control

A. Inspect wire and cable for physical damage and proper connection.

B. Torque test conductor connections and terminations to manufacturer's recommended values.

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TRAFFIC MANAGEMENT SYSTEM BUILDING EQUIPMENT

Grounding and Bonding Installation

A. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use 2 AWG bare copper conductor.

B. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

C. Interface with site grounding system installed.

D. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

E. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

F. Do not use spring steel clips and clamps.

G. Do not use powder-actuated anchors.

H. Do not drill or cut structural members.

Electric Service Ground

A. Ground electrical service system neutral at service entrance equipment to grounding electrodes.

B. Bond together system neutrals, service equipment enclosures, and equipment grounding conductor at service entrance.

C. Connect electric service grounding electrode conductors to incoming metal water pipe system (when available, using suitable ground clamp) and to ground rod, ground loop, or other supplemental electrode.

D. Provide grounding and bonding at power company metering equipment.

Equipment Ground

A. Provide complete ground system for building consisting of copper cable, ground rods, and exothermic connections to serve service entrance, building structural steel, metallic enclosures, and conduit systems.

B. Provide separate, insulated equipment grounding conductor from main service ground to each main switchboard and in feeders and branch circuits. Terminate each end a grounding lug, bus, or bushing. Do not use conduit as grounding conductor.

C. Provide bonding jumper at expansion joints, points of electrical discontinuity, or connections in conduit where firm mechanical bond is not possible, such as flexible connections and insulating couplings.

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TRAFFIC MANAGEMENT SYSTEM BUILDING EQUIPMENT

D. Ground each lighting and power panelboard by connecting grounding conductor to grounding stud.

E. Bond every new item of equipment served by electrical system to building equipment ground system including switchboards, panelboards, disconnect switches, receptacles, controls, fans, air handling units, pumps, and flexible duct connections.

Field Quality Control

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

Panelboards –

Installation

A. Install panelboards plumb and flush with wall finishes, in conformance with NEMA PB 1.1. Mount securely to walls or structural spaces. Mount floor mounted panelboards on 4-inch housekeeping pads.

B. Height: Install wall mounted panelboards at 6 feet to the top of the enclosure.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typewritten circuit directory for each branch circuit panelboard mounted in permanent, clear Lexan card holder located on inside of door. Prepare directories only after permanent room numbers have been assigned. Do not use room numbers shown on construction drawings.

E. Stub three empty 1-inch conduits to accessible location above ceiling out of each recessed panelboard.

F. Distribute loading on circuits in panelboards to balance the load as evenly as possible in each phase.

G. Provide duplex receptacle on side of each surface mounted 120 volt panelboard.

H. Terminate only one conductor under each lug of branch circuit breakers.

I. Do not make splices or taps in panelboard gutters.

Field Quality Control

A. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

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TRAFFIC MANAGEMENT SYSTEM BUILDING EQUIPMENT

Uninterruptible Power Supply-

Field Quality Control

The following inspections and test procedures will be performed by factory trained field service personnel during the UPS start-up.

Visual Inspection

A. Inspect equipment for signs of shipping or installation damage.

B. Verify installation per drawings.

C. Inspect cabinets for foreign objects.

D. Verify neutral and ground conductors are properly sized and configured.

Mechanical Inspection

A. Check all power modules are correctly fitted.

B. Check all battery modules are correctly fitted.

C. Check all terminal screws, nuts, and/or spade lugs for tightness.

Electrical Inspection

A. Confirm input voltage and phase rotation is correct.

B. Verify bypass voltage jumper is correct for voltages being used.

Unit Start-Up and Site Testing

The manufacturer’s field service personnel will provide site testing. Site testing consists of a complete test of the UPS system and the associated accessories supplied by the manufacturer. A partial battery discharge test will be provided as part of the standard start-up procedure. The test results will be documented, signed, and dated for future reference

Electrical Testing-

General Test electrical systems and equipment.

A. These tests are required to determine that the equipment involved may be safely energized and operated.

B. Perform tests by and under the supervision of fully experienced and qualified personnel. Advise each respective manufacturer's representative of tests on their equipment.

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C. Record all test data.

References

A. ANSI/IEEE C37.20 - Circuit Breakers, Switchgear, Substations, and Fuses.

B. NEMA WC 8 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

C. NFPA 70 - National Electrical Code.

Submittals

A. Submit test report forms for review a minimum of 45 days prior to requesting a final review by A/E.

B. Furnish six individually bound copies of test data. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken, both prior to and after any corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation.

C. A/E will retain one copy. Remaining copies will be returned to Contractor for inclusion in the operation and maintenance manuals.

Preparation

A. Furnish proposed test procedures, recording forms, list of personnel and test equipment for A/E review.

B. Follow recommended procedures for testing as published by test equipment manufacturer.

Wire and Cable

A. Test insulation resistance of each main feeder and service after the installation is complete but before the connection is made to its source and point of termination.

B. Test insulation resistance using Biddle Megger or equivalent test instrument at a voltage not less than 1,000 volts DC. Measure resistance from phase-to-phase and phase-to-ground. In circuits where insulation test value is lower than 1 megohm, remove and replace conductor and retest.

C. Visually inspect connections of every branch circuit for tightness.

D. Ensure that grounding conductor is electrically continuous.

E. Test branch circuits against grounds, shorts or other faults.

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REVISION OF SECTION 614
TRAFFIC MANAGEMENT SYSTEM BUILDING EQUIPMENT

F. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

G. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment.

H. Test system for stray currents and ground shorts. If stray currents and shorts are detected, eliminate or correct as required.

Wiring Devices

A. Operate switches at least twice.

B. Test every convenience outlet with plug-in device for proper phasing and grounding.

C. Demonstrate operation of lighting circuits and lighting control systems.

Secondary Grounding

A. Test service entrance ground resistance.

B. Provide additional made-electrodes if resistance is more than 3 ohms.

C. Test grounding system resistance within building at a minimum of ten locations.

Power Distribution Unit

A. Include the following tests:

1. Quality assurance inspections during production.
2. Production acceptance tests on finished PDU, including complete functional testing.

Packaged Engine Generator System

A. Demonstrate operation of standby system with voltage check while the entire electrical system is operating at system full load condition to assure proper operation of generator, transfer switches, etc.

B. Simulate standby power conditions by operating main overcurrent devices to simulate a loss of main electrical power to the building.

C. Verify operation of all transfer switches and operation of all equipment on standby power. Check and adjust all delays and timing sequences.

D. Test alarm and shutdown circuits by simulating conditions.

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REVISION OF SECTION 614
TRAFFIC MANAGEMENT SYSTEM BUILDING EQUIPMENT

Access Control System

A. Test the system to determine that it is free from grounds, open and short circuits.

B. Test system in accordance with manufacturer's recommendations in presence of Owner's representative:

1. Operate initiating devices.
2. Verify device operation.
3. Verify signal operations.
4. Verify system responds properly

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

REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION

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

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 burs 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.

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REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION

Testing: A local field operations test shall be performed to demonstrate that all hardware, cables, and connections furnished and installed by the Contractor operate correctly and that all functions are in accordance with the requirements described herein. The power supply voltages and the functionality of the cabinet fans and heaters shall be verified. The contractor shall provide CDOT a 5-Day pretest notification and test completion notification. In addition, the Contractor shall prepare a Device Data Sheet (CDOT Form 1411) for each installed device and submit to CDOT.

A subsystem communication throughput test over the communication path between each field device and the communications hub shall be performed. The testing shall occur after all communication installation for a particular site has been completed, the communication paths between the device and the communications hub have been functional for at least 48 hours, and all fiber optic tests have been successfully passed. The Contractor shall notify CDOT at least 7 Days prior to beginning testing.

After successful completion of all subsystem test procedures and after all mainline lanes as well as ramps are open, each site shall be tested for proper functionality and device availablitly for 30 consecutive Days. During the testing period, all equipment at the site that was provided, installed, or relocated by the Contractor shall operate without failures of any type. If any component malfunctions or fails to provide the capabilities specified herein during the 30- Day test period, within 48 hours of notification by CDOT, the Contractor shall troubleshoot to find the exact cause of the failure. The cost of correcting equipment malfunctions shall be the responsibility of the Contractor. After the component malfunction has been corrected to the satisfaction of CDOT, the 30-Day test period shall be restarted.

A CDOT staff member or an authorized CDOT representative shall witness and sign off on all tests.

REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXING ATTENUATOR

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

Coarse Wavelength Division Multiplexing Attenuator shall be installed in all Ciena 3930 Carrier Ethernet Service Delivery Switches, the Ciena 5142 Carrier Ethernet Service Aggregation Switch and the Ciena 5150 Carrier Ethernet Service Aggregation Switches to reduce optical signal power to a level specified by the coarse wavelength division multiplexing (CWDM) small form factor pluggable (SFP) optic modules. The attenuator shall be installed in the receive port of the CWDM SPF. All coarse wavelength division multiplexing attenuators shall be compatible with the CIENA CWDM SFP optic modules.

MATERIALS

The Contractor shall furnish and install single mode, 9/125um CWDM wavelength independent attenuators to match the wavelength of the SFP optic modules installed in the Ethernet switch in wavelengths of:

1430nm, 1450nm, 1470nm, 1490nm, 1510nm, 1530nm, 1570nm, 1590nm and 1610nm. In the design of this network, the 1550nm wavelength will not be used.

Attenuators for 1310nm wavelength SFP optic modules will not be required.

The Contractor shall furnish and install a female to male plug type fiber optic attenuator. The types of fiber optic attenuators to be supplied shall match both the termination panel bulkhead and the fiber optic pre-connectorized patch cable connectors.

The attenuators shall meet the following minimum specifications:

(1) Return Loss: Less than 65dB (APC)

(2) Attenuation Accuracy: +/-0.5 (1~10) +/-1.0(11~30)

(3) Polarization Dependent Loss: Less than 0.2dB

(4) Maximum Optical Input Power: 200mW

(5) Operating Temp Range: -40~80°C

(6) Low Polarization Dependent Loss **(**PDL**)**

(7) Tolerate high power UPC polished

(8) Minimum 500 connect/disconnecting tested

The CWDM attenuators to be provided shall be Bellcore Compliant.

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REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXING ATTENUATOR

CONSTRUCTION REQUIREMENTS

After all splicing and testing is completed the Contractor shall test the optical power of the incoming, (Receive) signal at each field Ethernet switch location. To obtain the most accurate values of optical power, the testing equipment shall be attached to the SFP optic end of the pre-connectorized patch cable to be installed at that location.

Once the optical power has been tested, the Contractor shall install the appropriate CWDM attenuator in the receive port of the CWDM SFP to meet the receive values of the CWDM SFP optic module.

Prior to installation, all attenuators shall be cleaned with lint-free fiber wipes moistened with Isopropyl Alcohol 99% U.S.P. After cleaning with alcohol, the bulkhead shall be cleaned with an optical connector cleaner to ensure that all residue is removed.

REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXOR - OPTICAL TIME DOMAIN REFLECTOMETER

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

For this project Coarse Wavelength Division Multiplexing – Optical Time Domain Reflectometer (CWDM-OTDR) shall be a modular testing unit capable of testing coarse wavelength division multiplexing (CWDM) optical networks. After project usage by the Contractor for fiber testing and analysis for the network turn up, the CWDM-OTDR shall become the property of the Colorado Department of Transportation, Colorado Transportation Management Center. The turnover shall be after the Contractor has completed all of the proposed fiber optic testing as stated in the project specifications.

MATERIALS

The CWDM-OTDR shall be a portable device and shall have the ability to test 10 CWDM wavelengths including 1430nm, 1450nm, 1470nm, 1490nm, 1510nm, 1530nm, 1550nm, 1570nm 1590nm and 1610nm and shall meet with the following minimum requirements:

CWDM-OTDR Modular Test Unit Platform

(1) The test set display shall have a 6.4” minimum color touch screen and shall offer the option of an optional outdoor enhanced screen.

(2) The CWDM-OTDR shall be modular with at least 2 supported modules for optical testing, Ethernet, SDH, OSA and CD/PMD.

(3) The platform shall support the use of a Fiber Inspection Probe with end-face analysis software.

(4) The platform shall provide at least two USB 2.0 ports, one RJ-45 LAN 10/100/1000 Mbit/s, one headset jack.

(5) Internal Storage - The test unit shall have 8 GB minimum internal memory, with this ability for a 16 GB internal memory upgrade configuration.

CWDM-OTDR Module Unit shall provide the following

(1) Support ITU-based CWDM wavelengths of ±3nm of central wavelength.

(2) Support the intelligent Optical Link Mapper (iOLM) application

(3) Use a dynamic multipulse acquisition that combines all the results into a single view, a single report and a single file.

(4) Automatically adjust the test parameters in function of the link under test with no intervention from the user.

(5) Have a dynamic range of minimum 40dB per wavelength.

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REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXOR - OPTICAL TIME DOMAIN REFLECTOMETER

(6) Display the fiber elements in a linear view with representative icons for splice, connector, macro bend, splitter and end of fiber.

(7) Display individual pass/fail status for each element of the network as well as a clear pass/fail status, all in the same window.

(8) Prompt specific and detailed diagnosis on how to fix the network based on the failure cause found by the unit.

(9) Capable of measuring the first connector of the network without the use of a launch cable.

(10) Capable of using pre-defined or user-defined templates to set the pass/fail thresholds and identify the link information accordingly.

(11) Test configurations should not include pre-defined test parameters such as pulse width, distance range or averaging time as these parameters should be always set by the unit automatically.

(12) Support multiple level of auto-increment for file naming, be flexible for the number of increments and be flexible for the label name of increment.

(13) Support, with user-defined, a minimum, a maximum and a maximum + minimum threshold for pass/fail status.

(14) Be capable of generating reports in HTML format, directly from the platform.

(15) Combine single mode and multimode testing into a single module

(16) Have an event dead zone of maximum 0.8m on a -45dB reflectance, measured at 1.5dB on each side below the peak.

(17) Have an attenuation dead zone of 4.5 meters or shorter on a -45dB reflectance, measured 0.5dB above the backscattering level.

(18) Have a minimal sampling resolution of 0.04 meters.

(19) Capable of storing over 5,000 OTDR traces

(20) Shall be supplied with a batch post-processing software to generate reports, analyze the results, edit/add information to the files, for multiple files simultaneously.

The OTDR unit shall be used as a CW source to the selected wavelength for loss measurements.

The OTDR unit shall have a linearity of ±0.03dB/dB or better.

The OTDR unit shall have a distance accuracy of ± (0.75 m + 0.0025% x distance) or better.

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REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXOR - OPTICAL TIME DOMAIN REFLECTOMETER

The CWDM-OTDR shall include the minimum following performance features:

(1) A suspend mode from which the test set shall return to a "ready to test" state within 10 seconds.

(2) Support the capability to run multiple applications and programs simultaneously.

(3) Provide a multi-tasking environment and the capability to switch between different running applications.

(4) The operating system shall be based on Windows OS technology and shall provide access to the Windows desktop.

(5) The batteries shall be rechargeable lithium-ion batteries providing at least 8 hours of OTDR/iOLM operation as per Bellcore GR-196.

(6) Shall operate while connected to a power supply (AC/DC adapter, input 100-240 VAC, 50-60 Hz) with or without the battery connected.

(7) There shall be housing for the ability to provide for a built-in optional VFL and power meter (InGas or GeX, with or without CWDM frequencies).

(8) The option for the following wireless interfaces:

a) 3G (additional hardware accessory)

b) Wi-Fi (built in hardware option)

c) Bluetooth (built in hardware option)

The CWDM-OTDR shall include the minimum following management features:

(1) Cloud –based server application for device management with direct communication link to in platforms in the field.

(2) Provides secure data storage and automatic backup of all data.

(3) The server application supports communication (interoperable) with multiple platform types for broad-based applications.

(4) The server application supports the automatic detection and synchronization of a platform to the server.

(5) The management application supports the automatic upload of device inventory information to management application (no manual data entry).

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REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXOR - OPTICAL TIME DOMAIN REFLECTOMETER

(6) The management application supports the automatic upload and display of all platform inventory data including: name of platform, alias, serial number, platform type, name of last user, name of the owner of the platform, test modules installed in platforms and all installed software and versions.

(7) The management application supports the automatic, parallel distribution of software (push) to multiple (100+) user defined platforms simultaneously.

(8) The management application supports the automatic, parallel distribution (push) of any file format including test configuration profiles to multiple (100+) user defined platforms simultaneously. File types should include but not limited to (.txt, .csv, .xls, .ppt, .doc, .pdf, .mp4, .avi, .wmv,)

(9) The management application supports the ability to create customized reports based on the inventory data.

(10) The management application supports the ability to create customized report templates that can be run on the database at any time.

(11) The management application supports the automatic upload of test results directly from the platforms in the field. Supported test report uploads includes: Ethernet test reports (Y.1564, RFC2544, BERT), SONET/SDH reports (BERT), physical layer reports (OTDR, PMD, Chromatic dispersion (CD), Optical loss tests (OLTS), Optical spectrum analyzer (OSA)).

(12) The management application provides search/filter capabilities to quickly pinpoint any test.

(13) The management application provides a standardized format for all uploaded test results.

The CWDM-OTDR shall have the ability for both fiber optic inspection and the analysis of the findings by the device and include the minimum following Optical Verification and Performance Testing features:

(1) The unit must support a fiber inspection probe for connector end-face inspection as well as on-board automated pass/fail analysis.

(2) The fiber inspection probe shall have an Auto center feature that is compatible with single fiber connectors and MPO/MTP connectors.

(3) The inspection probe shall have an Auto focus feature that is compatible with single fiber connectors and MPO/MTP connectors

(4) The fiber inspection probe shall support 3 levels of magnifications :

a) High Magnification field of view: 304 µm x 304 µm

b) Medium magnification field of view: 608 µm x 608 µm

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COARSE WAVELENGTH DIVISION MULTIPLEXOR - OPTICAL TIME DOMAIN REFLECTOMETER

c) Low magnification field of view: 912 µm x 912 µm

(5) The fiber inspection probe shall have a capturing device of 5 megapixel CMOS or better.

(6) The fiber inspection probe shall have a blue LED light source.

(7) The fiber inspection probe shall have a resolution of 0.55µm or better.

(8) The fiber inspection probe shall have a rugged design with rubber over molding for field applications.

(9) The fiber inspection probe should have a protective cap to protect the probe tip from physical damage.

(10) The fiber inspection probe shall support drop test resistance of 1 meter on a concrete surface on various axis

(11) The fiber inspection probe shall have a Pass/Fail status LED on the probe body.

(12) The fiber inspection probe shall have a capture and analysis button.

(13) The fiber inspection probe shall be compatible with handheld display, portable platforms or laptop/PC.

(14) The fiber inspection probe unit shall weight ≤0.3 kg (0.66 lb)

(15) The fiber inspection probe unit shall support operating temperature of -10°C to 50°C and storage temperature -40°C to 70°C.

(16) The fiber inspection probe unit shall allow the user to retest the same connector without affecting the file naming and report structure.

The fiber inspection probe must support a wide variety of inspection tips including but not limited to :

(1) FC/SC APC tip for bulkhead adapter

(2) LC tip for bulkhead adapter

(3) LC angled tip for bulkhead adapter (60º)

(4) LC/APC tip for bulkhead adapter

(5) FC and SC angled tip for bulkhead adapter (60º)

(6) SC tip for PC bulkhead adapter (extended)

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COARSE WAVELENGTH DIVISION MULTIPLEXOR - OPTICAL TIME DOMAIN REFLECTOMETER

(7) ST tip for bulkhead adapter

(8) Universal patch cord tip for 1.25 mm ferrule

(9) Universal patch cord tip for 1.25 mm APC ferrule

(10) Universal patch cord tip for 2.5 mm APC ferrule

(11) ODC Socket (male) tip

(12) ODC 2 Pin Plug (female) Guide & Universal tip

(13) Optitap

(14) MPO/MTP UPC and APC

(15) The unit shall support the IEC-3-35/IPC 8497-1 standards or user-defined acceptance criteria.

(16) The pass/fail connector analysis time shall be under 5 seconds

(17) The application shall have a focus protection in the software to prevent out-of-focus image analysis

(18) The connector analysis's focus level should appear in the test reports to ensure integrity of the results.

(19) The unit shall be capable of modifying existing connector analysis standard criteria directly from the platform's application without the need of external software.

(20) The unit shall be capable of generating reports directly from the field instrument without the need of external software.

Additional accessories and material to be provided with the CWDM-OTDR shall be:

Protective carrying case

(1) Optical fiber trace software for report generation

(2) Warranties

(3) Configuration Certification

(4) All Miscellaneous cabling

(5) Instructions on all equipment units

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REVISION OF SECTION 614
COARSE WAVELENGTH DIVISION MULTIPLEXOR - OPTICAL TIME DOMAIN REFLECTOMETER

The CWDM OTDR shall include as part of the cost, a full warranty by the manufacturer's direct service and support. Service and support from a third party other than the manufacturing company shall not be accepted. This service and support shall be available both during and after the CWDM-OTDR warranty period.

The manufacturer shall offer toll free phone technical service. In the event that repairs are required, the manufacturer shall have a maximum 3 day turnaround time in shipping the CWDM-OTDR fully repaired.

As part of the furnishing of the CWDM-OTDR, onsite manufacturer representative shall provide training in the proper use of the CWDM-OTDR. Training costs shall be included in the cost. See project Specification 614 – Test and Support Equipment for detailed requirements of the training.

REVISION OF SECTION 614
TEST AND SUPPORT EQUIPMENT

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

For this project Test and Support Equipment shall include furnishing test equipment required to successfully turn up, test and analyze the fiber optic coarse wavelength division multiplexing Ethernet fiber optic network on this project. The equipment shall be used by the Contractor during the project construction time then delivered to the Colorado Department of Transportation, Colorado Transportation Management Center at the end of all network fiber optic testing and network acceptance.

MATERIALS

The Contractor shall purchase the test and support equipment prior to the installation of the fiber optic cable. The Contractor shall keep all equipment at a secured location to ensure that no loss or damage is caused by either vandalism or theft. At the end of the fiber optic network installation and acceptance, all test and support equipment shall become the property of Colorado Department of Transportation, Colorado Transportation Management Center.

The following equipment shall be included in Test and Support Equipment. This equipment shall be used in the manner as stated in the Project Specifications as part of this project for fiber optic cable testing. An independent specification is provided in the project specification package for this item. The Contractor is required to submit cut sheet submittals for equipment included in this specification.

Coarse Wavelength Division Multiplexing, Optical Time-Domain Reflectometer

The Coarse Wavelength Division Multiplexing, Optical Time-Domain Reflectometer (OTDR) shall include but not be limited to the OTDR unit, individual Coarse Wavelength Division Multiplexing (CWDM) testing modules, fiber inspection probe, cabling, OTDR trace reading software, operational documentation, protective case, calibration documentation, power cabling, warranties and all other materials provided with the original Coarse Wavelength Division Multiplexing, Optical Time-Domain Reflectometer purchase.

The Contractor shall purchase the test equipment listed prior to the installation of the fiber optic cable. During this time the Contractor shall become familiar with the equipment in preparation for use during the testing of the optical network. Once the optical fiber network is ready, the Contractor shall use this equipment for the CWDM testing.

Once the fiber optic network testing has been completed and the optical network has been accepted, the Contractor shall make arrangements for the transfer of all test and support equipment. The equipment shall be in “like new” condition with only normal wear and shall be fully tested and recalibrated prior to turnover. All recalibration and any required refurbishing to bring the equipment to the like new condition shall be conducted by the equipment manufacturer at Contractor’s expense as part of the pay item and shall be at no additional cost to the project. All materials, hardware, accessories and cases associated with the test and support equipment shall also be turned over to the Project Engineer.

The Contractor shall schedule and provide training for the CWDM OTDR to the Colorado Transportation Management Center (CTMC) personnel. The training shall be scheduled and held in a meeting

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REVISION OF SECTION 614
TEST AND SUPPORT EQUIPMENT

conference room at the CTMC in Golden Colorado. The Contractor shall work with Project Engineer to schedule and reserve the conference room at the CTMC.

The training shall be presented in person at the CTMC by the manufacturer's technical representative. Web conferencing / remote conferencing shall not be allowed. The Contractor shall schedule with the manufacturer to have a manufacturer's representative be on site at the CTMC to conduct the training. The Contractor may combine his training with the training for CTMC personnel utilizing the project purchased equipment for training purposes.

METHOD OF MEASUREMENT

Test and Support Equipment will be measured as a lump sum item furnished in accordance with the Project Specifications. The Test and Support Equipment shall include an Optical Spectrum Analyzer along with all associated materials, accessories and hardware for the equipment. All manufacture warranties shall be transferred to the Colorado Department of Transportation, Colorado Transportation Management Center upon the turnover of all materials. Also included shall be the onsite training by the manufacturer's technical representative.

REVISION OF SECTION 614
INTELLIGENT TRANSPORTATION SYSTEM POLE

Section 614 of the Standard Specification is hereby revised for this project as follows:

DESCRIPTION

Subsection 614.01 shall include the following:

ITS poles are to be used for the mounting of various Intelligent Transportation Systems devices and communications cabinets along the highway, excluding CCTV cameras which shall be mounted on steel poles. The Developer shall furnish and install poles shall be made of composite fiberglass material and be of breakaway design. They shall be direct burial type which requires no base plate or concrete foundation. Poles shall be 30 feet in height and shall include all work for installation.

MATERIALS

Subsection 614.08 shall include the following:

(a) *ITS Pole*. The pre-fabricated, non conductive, non-corroding composite fiberglass poles shall be designed for installation directly into the ground including a breakaway device which meets the Federal Highway Administrations safety guidelines.

The poles shall be constructed per the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic SIGNALS standards with a 30% gust factor.

The breakaway design shall also comply with current AASHTO LTS-2 Street Lighting Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic SIGNALS by the same manufacturer as the pole.

The poles shall not be painted. Coloring shall be by pigment in the composite fiberglass resin during the manufacturing process. The poles shall be coated with polyurethane which includes ultraviolet inhibitors to help prevent fading.

Subsection 614.10 shall include the following:

(b) *ITS Pole*. The pole shall be tapered round and be constructed by the filament winding process from thermosetting polyester resin and contain a minimum of 65 percent "E" type fiberglass by weight. The filament windings shall be continuously applied with uniform tension and shall be placed on the pole helically at low angles to provide axial strength. Additional windings shall be placed on the pole in a circular manner to provide compressive strength.

The resin used to make the pole shall be ultraviolet resistant and pigmented approximately the same as the final coating to be applied. The color shall be brown and uniform throughout the entire wall thickness. A weather resistant, pigmented, polyurethane coating shall be applied to the pole and have a dry film thickness of 1.5 mils.

The pole shall be flame resistant in accordance with ASTM D635. In tests, samples must cease to burn before the gauge mark of 3.9 inches is reached.

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REVISION OF SECTION 614
INTELLIGENT TRANSPORTATION SYSTEM POLE

All surface and ends shall have a smooth finish with no burs or blemishes. The top of the pole shall be supplied with a cap to match the color and diameter of the pole.

The pole surface shall be tested for a minimum of 2500 hours of accelerated testing in accordance with ASTM G53-84 (UV-B Lamp 313 NM wavelength 130º F, cycle lamp 4 hour on, 4 hours off) with no fiber exposure, no crazing, no calking and with only minor color variations.

Stabilization of the pole shall be by a two-part polymer material recommended and provided by the manufacturer. This material shall be environmentally safe to the worker and the surrounding area. The Developer shall use care while combining the material on site so no overspill occurs. All remaining material not used in the installations of the poles shall be cleared from the site by the Developer, and surrounding area returned to pre-installation conditions.

REVISION OF SECTION 614
LANE CONTROLLER CABINET

Section 614 of the Standard specifications is hereby revised for this project as follows: Subsection 614.01 shall include the following:

Lane controller cabinet shall be furnished and installed at designated Intelligent Transportation System (ITS) field device sites to house and protect ETC components.

Lane controller cabinets shall be UL 508A *Industrial Control Panels* listed and conform to a NEMA Type $4X^2$ rating. They 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 a minimum of 48 inches wide, 48 inches tall, and 24 inches deep.

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 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 . Hinges shall be mounted with appropriately sized stainless steel hardware. The door shall be equipped with a hasp and staple for padlocking. As an option, the Department prefers that a Corbin #2 key lock be utilized in place of the hasp and staple if the NEMA 4X rating can be maintained. A document holder constructed of high-impact thermoplastic shall be provided for each lane controller cabinet and permanently mounted to the lower portion of the inside door. The Developer shall insert a copy of the lane controller cabinet Bill of Materials (BOM), individual cabinet component specification sheets and an asbuilt electrical/low-voltage wiring diagram of the lane controller cabinet in the document holder.

Each lane controller cabinet shall have tapped pads to provide for the mounting of a back panel as specified herein. Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.

Two conduit access holes shall be made on the bottom of the lane controller cabinet for electrical wiring, specific field device low-voltage control cabling, waveguides and fiber optic cabling, as applicable for each lane controller 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.

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REVISION OF SECTION 614
LANE CONTROLLER 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 . Two back panels and associated mounting hardware shall be included with each lane controller cabinet and be rated for use in NEMA 4X cabinets. The back panel shall be approximately 1-inch less than the inside dimensions and protected on one side with a plastic film. The back panel shall be 1-inch thick, with air space to allow for mounting screws to be used from either side without protrusion through the opposing face. The back panel shall be mounted within the lane controller cabinet with a minimum of four screws.

Outlet Box

A minimum of 10 NEMA 5-20R receptacles shall be provided per toll point within outlet boxes opposing the external service disconnect. At the combined tolling point, 20 NEMA 5-20R receptacles shall be provided. NEMA 5-20R receptacles shall be rated for 125 VAC, 0.5 HP and 20 A. It shall be of commercial grade quality and be manufactured from high strength nylon. NEMA 5-20 receptacles shall have two poles, three wires and include a self-grounding strap to insure ground contact. Receptacles shall be UL listed.

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.

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) × 2.25 inches (w) × 4 inches (d) and a weight of not more than 1.5 lb. One 12 VDC power supply shall be provided with each lane controller cabinet.

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REVISION OF SECTION 614
LANE CONTROLLER CABINET

Warranty

The lane controller 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 lane controller cabinet materials and workmanship, including pole mounting kits, for two (2) years after delivery of each lane controller cabinet.

REVISION OF SECTION 614
TRAFFIC LOOPS AND PIEZOS AT AUTOMATED TRAFFIC RECORDER (ATR) SITES

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of the removal and replacement of loop detector wires, or loops and piezoelectric axle sensors (piezo) for the Automatic Traffic Recorder (ATR), where the loops, piezos or both have been removed within a project site. Work shall be in accordance with this specification and as shown on the plans.

MATERIALS

Loop detector wire shall consist of specified loop wire encased in ¼ inch OD, 3/16 inch ID vinyl or polyethylene tubing. (14-1/C Loop detector cable 19 STR. PVC/Nylon/PVC Tube 600v IMSA 51-5)

Loops shall be sealed with a two-part self-curing, self-bonding weatherproof epoxy approved for sealing loops. Loops shall be 6 feet by 6 feet.

The piezo shall be class II and 6 feet in length. The piezo shall have sufficient lead in cable, so the lead in cable can be pulled in to the cabinet without splicing.

Grout or epoxy for the installation of the loops and piezos shall conform to manufacturer's recommendations.

Pull boxes shall be in accordance with Section 613.

CONSTRUCTION

(a) *General.* A minimum of five days prior to installation, the Developer shall submit a schedule of installation activities including alternative scheduling to the CDOT DTD Project Manager and the Traffic Data Collection (TDC) Manager (Mike DelCupp 303-757-9816 robert.delcupp@dot.state.co.us). The installation instructions from the manufacturer shall also be submitted for approval. Installation of loops and piezos shall not begin until approval has been received from CDOT DTD.

The Developer shall install the loops and piezos as close to the locations shown on the plans as possible. Exact locations, dimensions, and configurations may vary based on site conditions, and shall be as approved by CDOT DTD.

All work will be inspected by the Traffic Data Collection Unit (TDC) during installation. Acceptance will be based on the testing and operation of the piezos and loops under actual traffic conditions, in which one week of actual data will be collected. The volume and vehicle class shall be within ±10 percent for the site compared to historical data for the same time period. There shall be no more than 1 percent sensor misses in any one lane for the same time period.

(b) *Installation of loops.* Loops shall be centered in the travel lane with two sides parallel to lane striping. The saw cut for the loops shall be made 3/8 inch wide and 3-½ inches deep. The saw slot shall be as straight as possible and shall not vary more than ½ inch when checked with a straightedge. No more than one set of loop lead wires shall be placed in one saw slot. Saw cuts

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REVISION OF SECTION 614
TRAFFIC LOOPS AND PIEZOS AT AUTOMATED TRAFFIC RECORDER (ATR) SITES

shall be hydro- blasted with a mixture of water and air and then blown free of water and debris with compressed air, using a large capacity air compressor of at least 150 CFM. The cuts shall be dry prior to placement of loop wire.

(c) The Developer shall locate all buried utilities, which may interfere with the planned location of the ATR site. The Developer shall contact the Utility Notification Center of Colorado (UNCC) at 811 or 1-800-922-1987 for location of member utilities at least three working days prior to any excavation, not including the day of actual notice.

The Developer shall also locate non-member utilities, such as storm sewer and ditch. Any utility conflicts encountered with the proposed installation shall be brought to the attention of the Engineer

After the saw slot is cleaned of debris and dried, the wire shall be placed for the loop by pushing it into the slot with a blunt non-metallic object. A screwdriver or other sharp tool will not be permitted. Care shall be used to avoid abrading or damaging the insulation.

All loop corners shall be rounded using a 1-½ inch hole drilled to a minimum depth of 3-½ inches. Loop leads shall be drilled when leaving the roadway surface at a 45 degree angle 8 inches from pavement edge out through the side or bottom of roadway, the drilled hole shall be no larger than ¾ of an inch. All holes shall be spaced a minimum of three inches from one another. No more than one set of loop lead wires shall be placed in one drill hole.

One continuous length of loop wire shall be used for each loop from pull box or cabinet around the loop with 4 turns and back to the pull box or cabinet with no splices. The wires shall be seated in the bottom of the saw slot. A ½-inch backer- rod shall be installed to insure wires do not float to the surface during grouting. Backer-rod shall be installed in 4 to 6 inch pieces with 1 to 2 foot gaps in- between, to insure the sealant will come in contact with the loop wire. One continuous piece of backer-rod will not be allowed.

Prior to sealing the loop, loop lead and feeder slots, a loop continuity test will be performed. The test will be performed by the TDC representative. Loop continuity shall be no higher than 1 ohm. Loop continuity higher than 1 ohm shall be cause for replacement of the loop. Replacement shall be at the Developer's expense.

After the loops are properly seated and tested, the slots shall be filled with a two- part self-curing, self-bonding epoxy or grout, as recommended by the manufacturer. Excess epoxy shall be removed to avoid unnecessary high spots, and level with the roadway surface.

Loop leads shall be pulled into cabinet without splices to match original installation when applicable.

All detector loops shall measure six feet by six feet.

Installation at an ATR count or classification site shall consist of one loop or one loop set (two loops) within a single lane. The loop sets shall be separated by 10 feet, plus or minus 1 inch,

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REVISION OF SECTION 614
TRAFFIC LOOPS AND PIEZOS AT AUTOMATED TRAFFIC RECORDER (ATR) SITES

resulting in a distance of sixteen feet from the leading edge of the first loop in the direction of travel to the leading edge of the second loop.

Loop and loop leads shall be installed directly into the pavement, to pavement edge, pull box or cabinet. If loops are installed during asphalt paving, the loops shall be installed before the final lift is placed.

Loop lead wires from pavement edge to pull box shall be enclosed in ¾ inch PVC conduit or ¾ inch rubber hose to protect wire from abrasion. Loop lead-in pairs from pavement edge, to pull box, shall be symmetrically twisted 5 turns per 1 foot. Pull boxes or cabinet shall contain a minimum of 3 feet of loop lead wire for splicing. All loop and loop leads shall be clearly in all pull boxes and or cabinet. The Developer shall be responsible for all trenching and digging from pavement edge to pull box.

All splices shall be made with approved waterproof pressure connector. All splices shall be capable of satisfactory operation under continuous submersion in water.

(d) *Piezo Installation.*

The piezo shall be permanently installed by grouting into the roadway, flush to 1/16 of an inch above the roadway surface by grouting into a concrete roadway or the final lift of asphalt.

Piezo sensors shall be installed in compliance with the manufacturer's recommendations.

The piezo shall be tested for capacitance and dissipation factor, prior to and after installation using a LCR meter. Capacitance and dissipation shall be within ±20 percent of the data sheet supplied with the piezo.

Prior to acceptance of the site, the TDC will test the piezo for voltage and signal quality with live traffic. Voltage shall be no lower than 80 millivolts on the front axle of a class II vehicle (car).

At an ATR axle classification site, one 6 foot piezo sensor per lane shall be installed at the exact midpoint between the two loops and to the right or left side of the line, centered in the wheel path.

The saw cut shall be as straight as possible and shall not vary more than ½ inch when checked with a straightedge. The size of the saw cut shall be to the manufacturer's specifications and not vary more then 1/8 of an inch in width. The slot for the piezo lead wire shall be 3 inches deep and 3/8 of an inch wide. Only one piezo lead wire shall be placed in the saw slot.

Piezo lead shall be drilled when leaving the roadway surface at a 45 degree angle 8 inches from the pavement edge out through the side or bottom of the roadway, the drilled hole shall be no larger than ¾ of an inch. All holes shall be spaced a minimum of 3 inches from one another. No more than one piezo lead wires shall be placed in one drill hole.

Saw cuts shall be hydro-blasted with a mixture of water and air and then blown free of water and debris with compressed air, using a large capacity air compressor of at least 150 cubic feet per minute. The cuts shall be dry and cleaned with acetone prior to placement of the piezo.

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REVISION OF SECTION 614
TRAFFIC LOOPS AND PIEZOS AT AUTOMATED TRAFFIC RECORDER (ATR) SITES

The piezo shall not be installed if roadway surface temperature is not above the manufacturer's recommended minimum temperature, or cannot be maintained above this temperature for a minimum of two hours after installation. The piezo shall not be installed if roadway surface temperature is above the manufacturer's highest recommended temperature for grout installation.

The piezo lead wire shall be placed in the saw slot with a blunt non-metallic object. ½ inch backer-rod shall be installed to insure the wire does not float to the surface during grouting. Backer-rod shall be installed in 4 to 6 inch pieces with 1 to 2 foot gaps in-between, to insure the sealant will come in contact with the piezo lead wire. One continuous piece of backer-rod will not be allowed.

The sealant for the piezo lead wire shall be the same as used for loops.

Piezo lead wire shall be pulled into the cabinet without splices, unless the length exceeds 300 feet.

Only one lead wire shall be placed in a saw slot.

Piezo lead wires from pavement edge to pull box shall be enclosed in ¾ inch PVC conduit or ¾ inch rubber hose, to protect wire from abrasion. Pull boxes or cabinet shall contain a minimum of three feet of piezo lead wire for splicing. Lead wire shall be clearly as approved by the Engineer and the TDC.

All splices in piezo wiring shall be soldered and enclosed in a resin filled splice kit.

(e) *Pull Boxes.* All pull boxes on the shoulder of the roadway surface shall be raised to finished grade or level with the surrounding ground. If the shoulder has been raised to the point that the *conduit* is below the bottom of the pull box, then the conduit shall be raised. All wiring splices for existing wiring shall be a minimum of 12 inches in length above the conduit.

All existing pull boxes that are found to be damaged shall be replaced.

(f) *Water Valves.* A minimum of two feet of slack shall be provided on the loop and piezo wires that are contained in water valves.

(g) No splices shall be allowed in water valves.

(h) *Pull Rope.* A 1/8 inch nylon pull rope shall be installed in all new conduits and all existing conduits where a wire or cable is added or an existing wire or cable is replaced.

(i) *Conduit.* The Developer shall seal all conduits with a sealing compound where a wire or cable is added or an existing wire or cable is replaced. The sealing compound shall be UL tested and approved for use. Sealing compound shall be a permanently soft, fibrous, non-staining sealer that can be easily applied and removed by hand at all working temperatures. Sealing compound shall be designed to seal out weather, moisture, dust rodents and atmospheric conditions both indoors and outdoors. No foam sealant will be allowed.

REVISION OF SECTION 614
CUTOVER

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of the maintenance of Intelligent Transportation System (ITS) devices during resetting and reconfiguring for testing communication, and performing cutovers.

CONSTRUCTION REQUIREMENTS

Throughout the duration of the project, the Contractor is responsible for the maintenance of all ITS devices contained within the limits of this project.

The Contractor shall submit a cutover plan to CDOT ITS for review prior to performing the work. This cutover plan shall detail how the Contractor will sequence the construction activities, so that the new backbone is installed and spliced into the existing devices and the traffic management system buildings such that 48-hours of downtime is not exceeded. The fiber optic backbone splicing shall be scheduled between Monday and Thursday, except holidays, such that ITS devices shall be fully functional during weekends and holidays.

Resetting and reconfiguring devices for communications and performing cutovers, as required, shall not exceed 48 hours of downtime and no more than two ITS devices shall be inoperable at any one time. The Contractor shall be charged a disincentive of $50 per hour per each device that is offline beyond 48 hours. The total amount shall be deducted from monies due to the Contractor. This disincentive shall not be considered a penalty, but shall be a disincentive to the Contractor for failure to bring ITS devices to fully functional capacity within 48 hours of the equipment being made offline. Offline is defined as time during which data is not being received by the CDOT Colorado Transportation Management Center (CTMC).

The Contractor shall be responsible for splicing and repair of backbone and lateral fiber optic cable that is damaged during construction if the damage occurs apart from the above mentioned planned cutover. If there is a fiber optic backbone outage caused by the Contractor's negligence, act, or omission under their control, then the disincentive shall commence upon notification of the outage and the Contractor shall be charged $50 per hour per device that is offline.

All proposed equipment, power, and all temporary communications necessary for maintaining ITS devices during construction shall be constructed and put in place prior to the cutover or reset in order to minimize downtime of devices.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

All work, materials, and equipment required to reset, reconfigure and perform cutover will not be measured and paid for separately, but shall be considered incidental to the work.

REVISION OF SECTION 614
ITS SYSTEM AS-BUILT DOCUMENTATION

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

The Contractor shall complete and transmit to the Project Engineer the ITS as-built documentation as part of the final submittals on the project.

MATERIALS

There are no materials requirements associated with this special provision.

CONSTRUCTION REQUIREMENTS

The Contractor shall document the as-built device, communications, and power infrastructure placement and material information. The Contractor shall clearly mark the plan sheets with red ink describing the as-built condition of all elements installed, including all changes made to fiber optic splicing. The as-built markups shall include the following information related to location markers:

(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.

At the end of the project, the contractor shall create a legible PDF scan of the marked up as-built drawings, and submit the hard copy and PDF to the Project Engineer.

The Contractor shall complete the following forms included in this special provision:

(1) Form 1411—ITS Device Installation Checklist
(2) ITS As-Built Documentation Form
(3) Fiber Optic Cable As-Built Documentation Form

Prior to filling out forms, the Contractor shall review the forms and instructions and request all necessary clarification from the Project Engineer. Instructions for Form 1411 are included in this special provision.

The contractor shall request from the Project Engineer electronic copies of the ITS As-Built Documentation Form and the Fiber Optic Cable As-Built Documentation Form. The Contractor shall fill out the electronic forms and provide the completed forms to the Project Engineer. The file name of the electronic forms shall include the form type, the five-digit construction subaccount number, and a description of the installation location.

METHOD OF MEASUREMENT

ITS As-Built Documentation will not be measured separately but will be considered incidental to the pay item being installed. This work shall include all labor, materials and equipment required to complete the work.

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REVISION OF SECTION 614
ITS AS-BUILT DOCUMENTATION FORM

FORM 1411

https://www.codot.gov/library/forms/cdot-1411

COLORADO DEPARTMENT OF TRANSPORTATION

ITS DEVICE INSTALLATION CHECKLIST (one form per device)

Project Engineer:	Installer:	Installation Date:
Engineer Contact #:	Installer Contact #:	

Device Type: ☐ CCTV ☐ VMS ☐ RWIS ☐ TTI ☐ Radar ☐ ATR ☐ Other: _____

Location: Roadway:_____ (Example: I-70) Direction:_____ (E) Crossroad:_____ (Wadsworth) Mile Marker:_____ (181.6)

Latitude:_____ (Example: 39.46532) Longitude: _____ (-104.3621) Altitude (in meters): _____

Manufacturer:	Model #:
Warranty Start:	Warranty Expiration Date:

Warranty Contact Information: _____ (Example: Vendor/Phone Contact)

Maintenance Responsibility: ☐ ITS ☐ Region _____ ☐ HLT ☐ EJT

IF REGION: ☐ Maintenance ☐ Traffic

Travel Time to Device from Golden, CO (To/From): _____ minutes

Equipment Access:_____ (Example: Bucket Truck, Ladder, Ground Level)

Roadway Closure Requirements for Maintenance:_____ (Example: Shoulder, Lane, Not Applicable)

Communications: ☐ Fiber ☐ Radio ☐ CDWH ☐ CDMA ☐ T1 ☐ Dial-Up ☐ Other: _____

Additional Communication Notes:_____ (Example: Phone#, MAC Address, etc.)

Device Purpose: ☐ Regulatory ☐ Safety ☐ Mobility ☐ Data Support ☐ System Support

Pictures: ☐ Inside of Cabinet ☐ From Traveling Direction ☐ From Opposite Travel Direction
☐ Any Physical Conditions That Could Affect Maintenance

Power Provider:	Contact:	Account:
Comm Provider:	Contact:	Account:

☐ Provide Redline as builts set of where Comm and Power Source from device back to provider to ITS Maintenance
(Contact Matt Rickard (303) 512-5634 with ITS Maintenance, with 3 weeks notice, for Acceptance when both Power and Comms are complete)

Additional Notes:

CDOT Form #1411 8/12

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REVISION OF SECTION 614
ITS AS-BUILT DOCUMENTATION FORM

FORM 1411 INSTRUCTIONS

The following instructions are provided for information to the Contractor. The Contractor shall direct all questions regarding form 1411 to the Project Engineer.

Project Engineer / Installer / Contact # / Installation Date

Fill in the name (first, last) of the Project Engineer and device Installer and phone numbers for both parties. Fill in the date of installation.

Device Type

Place a check next to the type of device being installed, or fill in the box marked "Other."

Location / Roadway / Direction / Crossroad / Mile Marker

Fill in the name of the major roadway on which the device is installed, the direction of travel on the side of road on which the device is installed, the nearest crossroad, and highway mile marker to the nearest hundredth of a mile. For the direction of travel, odd numbered highways are always considered north-south highways and even numbered highways are always considered east-west highways.

Latitude / Longitude / Altitude

Fill in the latitude, longitude, and altitude using the method described and the precision and accuracy defined in the special provision Revision of Section 614 – Global Positioning System (GPS).

Manufacturer / Model # / Warranty Start / Warranty Expiration Date / Warranty Contact Information

Fill in the manufacturer name, device model number, manufacturer warranty state date, warranty expiration date, and warranty contact information. The warranty contact information shall be the name and telephone number of the party responsible for addressing warranty issues with the device.

Maintenance Responsibility

With input from Project Engineer, check the applicable box to identify the CDOT personnel responsible for maintaining the device. If a specific CDOT region is responsible, define whether region maintenance or traffic group is responsible for maintenance.

Travel Time to Device from Golden, CO

Use a reliable mapping tool to provide an approximate travel time in minutes (assuming no traffic) from 425 Corporate Circle, Golden, Colorado, 80401 to the device location. Google maps, Apple maps, and Bing maps are examples of reliable mapping tools.

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REVISION OF SECTION 614
ITS AS-BUILT DOCUMENTATION FORM

FORM 1411 INSTRUCTIONS (CONTINUED)

Equipment Access

Briefly describe how maintenance personnel will access both the communications cabinet and device. If the communications cabinet is at ground level and the device requires a bucket truck for access, write "Cabinet ground level, device bucket truck" or something similar.

Roadway Closure Requirements for Maintenance

Describe what portion of the paved roadway is required to be occupied by a maintenance vehicle to access the communication cabinet and device.

Communications / Additional Communication Notes

Check the appropriate box for the type of communications used for the device, or fill in the box marked "Other." Provide additional applicable communications notes.

Device Purpose

With input from the Project Engineer, check the applicable box to identify the purpose of the device.

Pictures

Check that each described picture (at a minimum) has been taken and provided in a digital format to the Project Engineer. Label each picture file with the major street name, mile marker to the nearest hundredth, device type, and brief description of the picture (e.g. cabinet).

Power Provider / Contact / Account

Insert the name of the power service provider, power company contact phone number, and account number for the device service. If no new power service was provided for the device, fill in "NA"

Comm. Provider / Contact / Account

Insert the name of the communications service provider, communications service contact phone number, and account number for the device service. If communications is via CDOT's network, fill in "CDOT".

Provide redline as-builts

Check the box after redline as-builts of power and communications service points are provided as described.

Additional Notes

Fill in additional notes that are relevant to future maintenance operations.

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REVISION OF SECTION 614
ITS AS-BUILT DOCUMENTATION FORM

ITS AS-BUILT DOCUMENTATION FORM

COLORADO DEPARTMENT OF TRANSPORTATION **ITS AS-BUILT DOCUMENTATION FORM**							
Project Engineer:		Installer:		Installation Date:			
Engineer Contact #:				Installer Contact #:			
Fiber							
Cable Size:		Cable Type:		Owner:			
Cable Manufacturer:				Cable Length:			
Fiber Marker Sequential Between Devices:							
Optical Wavelengths to Each Communication Device at the Port Level:							
Patch Panel Size:		Patch Panel Type:		Port Status (Active/Unused):			
Patch Panel Manufacturer:				Patch Position (for each fiber):			
Communication Device							
Type:				Manufacturer:			
Configuration:				Port Type:			
Fiber Strand Corresponding to Each Active Port:							
Port Wavelength:							
Splice Enclosure							
Splice Enclosure Type:				Splice Enclosure Manufacturer:			
Owner:		Installer:		Date Installed:		Location Type:	
Location Description:				Grounding Method:			
Site-Specific Comments:							
Electronic Marker							
Marker Type:				Marker Manufacturer:			
Marker Color:				Marker Frequency:			
Conduit System							
Buried Depth:				Encasement Type:			
Manufacturer:		Model:		Measured Length:			
Length Source:		Duct Bank Height:		Duct Bank Width:			
Installation Date:		Material:		Construction Status:			
Duct Availabilty:							

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REVISION OF SECTION 614

ITS AS-BUILT DOCUMENTATION FORM

FIBER OPTIC CABLE AS-BUILT DOCUMENTATION FORM

COLORADO DEPARTMENT OF TRANSPORTATION

FIBER OPTIC CABLE AS-BUILT DOCUMENTATION FORM

TO NEXT PULL BOX OR MANHOLE

CABLE MEASUREMENT OUT:

PULL BOX OR MANHOLE ID:

MAJOR STREET OR HIGHWAY:

CABLE ID NUMBER:

CABLE MEASURMENT IN:

SPLICE POINT YES NO
CABLE END SPLICE YES NO
NUMBER OF LATERAL CABLES:

CABLE MEASUREMENT OUT:

PULL BOX OR MANHOLE ID:

MAJOR STREET OR HIGHWAY:

CABLE ID NUMBER:

CABLE MEASURMENT IN:

SPLICE POINT YES NO
CABLE END SPLICE YES NO
NUMBER OF LATERAL CABLES:

CABLE MEASUREMENT OUT:

PULL BOX OR MANHOLE ID:

MAJOR STREET OR HIGHWAY:

CABLE ID NUMBER:

CABLE MEASURMENT IN:

SPLICE POINT YES NO
CABLE END SPLICE YES NO
NUMBER OF LATERAL CABLES:

TO NEXT PULL BOX OR MANHOLE

Page:

REVISION OF SECTION 614
GLOBAL POSITIONING SYSTEM (GPS)

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

The Contractor shall provide Global Positioning System (GPS) Coordinate information for all device, conduit, pull box and manhole locations on this project. Coordinates of both proposed and existing devices in the project limits shall be provided.

MATERIALS

Documentation verifying the type of GPS unit being proposed for use and the specifications of the unit shall be provided to the Project Engineer for review prior to data gathering.

CONSTRUCTION REQUIREMENTS

The Contractor shall provide geodetic datum for all roadway devices, conduit, fiber optic pull boxes and manholes within the project limits. This shall include Intelligent Transportation System devices, communications cabinets, traffic signal controller cabinets, ramp metering cabinets, automated traffic recorder cabinets, conduit, pull boxes and fiber optic cable running line manholes.

The Contractor shall use a device designed specifically for mapping GPS information to Universal Transverse Mercator (UTM) Zone 13 coordinate system utilizing 1983 North American Datum (NAD83). Cell phones with GPS capabilities shall not be allowed for determining GPS location.

The GPS data shall be expressed in Latitude and Longitude and Universal Transverse Mercator (UTM) Zone 13 utilizing 1983 North American Datum (NAD83). Altitude shall be expresses in meters:

Latitude and Longitude shall be provided in Decimal Degree (DD) format to a precision of six decimal places.

Example - Latitude: _____ Longitude _____ Altitude (m) _____

North American Datum shall be provided in coordinates to a precision of three decimal places.

Example - X (easting) _____ Y (northing) _____ Z (m) _____

For data collection, the Contractor shall use the averaged waypoint. Minimum averaging time at each location shall be two minutes prior to documenting the information.

Accuracy tolerances for data collected by the GPS unit shall be within a maximum of 3 feet.

The Contractor shall completely fill in all information on the attached form for submittal to the Project Engineer.

METHOD OF MEASUREMENT

Global Positioning System (GPS) information gathering will not be measured separately but will be considered incidental to the pay item being installed. This work shall include all labor, materials and equipment required to complete the work.

Appendix B
Responsibility Matrix

Responsibility	Developer				E-470 System Integrator			Zayo			Department		
	Design	Construct	Maintain During Construction	Maintenance Post Construction	Design	Construct	Maintain Post Construction	Design	Construct	Maintain Post Construction	Design	Construct	Maintain post construction
Conduit Duct Bank d Fiber													
Conduit duct bank	X	X	X							X			
CDOT 144 count fiber optic cable, CCD 96 count fiber optic cable, 36 count shared resource fiber optic cable backbone and splicing (not laterals)								X	X	X			X (laterals only)
Electrical Power													
Power service to all ITS and ETC devices and cabinet	X	X	X	X									
Metered power sources for ITS and ETC devices	X	X	X	X									
Location, Protection of ITS and ETC Systems and Devices													
ITS and ETC infrastructure within the ROW	X	X	X	X			X						X
Existing ITS devices	X		X										X
All new equipment and devices	X	X	X										X
Existing underground facilities	X	X	X										X
Grounding system for all ITS and ETC devices	X	X	X										X
Communications System													
Fiber optic communication system lateral connections	X	X	X										X
Fiber Optic Backbone Splicing	X		X						X	X			
Fiber Optic design and splicing laterals to backbone and misc. equipment	X	X	X							X			X
All fiber allocations, splicing diagrams and network drawings	X	X	X										X
All components for fully-functioning communications system	X	X	X										X

Responsibility	Developer				E-470 System Integrator			Zayo			Department		
	Design	Construct	Maintain During Construction	Maintenance Post Construction	Design	Construct	Maintain Post Construction	Design	Construct	Maintain Post Construction	Design	Construct	Maintain post construction
Vertical Clearance Requirements													
All overhead sign structures	X	X	X	X									
Variable Message Signs													
VMS	X	X	X										X
All new VMS signs and associated equipment	X	X	X										X
Coordinate all VMS back to CTMC	X	X	X										X
Modifications to CTMC's software											X		X
Closed Circuit Television													
New CCTV cameras	X	X	X										X
Location of side-fire MVRD units	X	X	X										X
MVRD units and associated equipment	X	X	X										X
Modification to CTMC's software											X		X
Travel Time Indicators													
Location of TTI units	X	X	X										X
TTI units and associated equipment	X	X	X										X
Modification to CTMC's software											X		X
Division of Transportation Development Automatic Traffic Readers													
DTD ATR counting station and equipment	X	X	X										X
Modification to CTMC's software											X		X
Doppler Radar													
Existing speed Doppler radar units		X	X										X
Road Weather Information Systems													
New RWIS	X	X	X										
Impacted RWIS	X	X	X										X
Modification to CTMS's software											X		X
Enhanced Active Traffic Management Elements													
ATM devices added to CTMS		X	X								X		X

Responsibility	Developer				E-470 System Integrator			Zayo			Department		
	Design	Construct	Maintain During Construction	Maintenance Post Construction	Design	Construct	Maintain Post Construction	Design	Construct	Maintain Post Construction	Design	Construct	Maintain post construction
Variable Toll Message Signs													
VTMS system and associated equipment	X	X	X										X
VTMS into Camera Cameleon					X	X					X		X
Automatic Vehicle Identification Reader													
AVI antennas and readers					X	X	X						
Structure and miscellaneous hardware at tolling points	X	X	X	X									
Automatic License Plate Recognition Cameras and Loop Detector Wire													
ALPR cameras and loop detector wire					X	X	X						X
Support system for the ALPR	X	X	X	X									
Conduits and pull boxes	X	X	X	X									
Electronic Tolling Lane Controller													
Lane controller					X	X	X						X
Cabinets and foundations	X	X	X	X									
ALPR camera, transaction beacon					X	X	X						X
Enforcement Beacons													
Enforcement beacons					X	X	X						X
Pull Boxes and Manholes													
Pull boxes	X	X	X	X									
Cabling and Conductors													
All ITS and ETC System Conduits, Conductors and cables	X	X	X	X									

4. UTILITIES

4.1 General

4.1.1 This Section provides information on the Developer's, the Department's, and Utility Owner's roles and responsibilities associated with any existing or new Utility that is located or planned to be located within the Site, and any Service Line or Utility service in respect of any such Utility, including but not limited to how a Utility is to be protected, adjusted, upgraded, constructed, or incorporated into the Project.

4.1.2 Utility Work is necessary to accommodate the Project for the following reasons:

a. Utility avoidance;

b. The Utility Relocations;

c. Any Utility Betterment; or

d. Any Requested Relocation.

4.2 Utility Work Obligations

4.2.1 The Developer shall either execute a Utility No-Conflict Closeout Form or execute a Utility Work Order for every Utility located within the Site (excluding any Temporary Property that is not a Temporary Easement). The Developer shall develop procedures for addressing Utility Work during design and construction, in accordance with Schedule 8 (*Project Administration*).

4.2.2 The Construction Work will affect both existing and planned Utilities. The Department has coordinated with Utility Owners to provide the preparation of various preliminary planning, design, and schedule activities for the Utilities potentially impacted by the Project. The Utility Owner's preliminary planning, design and schedule (between Brighton Boulevard and Colorado Boulevard) to perform the Utility Owner's Utility Relocation is based on the design of the Project, as provided in Schedule 29 (*Reference Documents*).

4.2.3 The Developer shall coordinate and cooperate with the Department and the Utility Owners to ensure that all Utility Relocations and all Utility Work (whether performed or furnished, respectively, by a Utility Owner or by the Developer) is performed in accordance with the applicable URA and Utility Work Order. The physical limits of the Developer's obligation for the performance of Utility Work shall extend as far as is necessary to accommodate a Utility Relocation (taking into account the requirements of the Utility Owners, Governmental Authorities, and adjacent property owners).

4.2.4 The Developer shall use Reasonable Efforts to anticipate and avoid Utilities, and to otherwise minimize and/or mitigate the consequences of Utility Work.

4.2.5 The Department anticipates that the review and Permit fee process set out in Section 4 of the Denver IGA shall apply with respect to the performance of the Utility Work by the Developer.

4.2.6 The Developer shall be responsible for performing all Utility Work in accordance with the requirements of the URAs, this Section, and other relevant provisions of the Agreement.

4.2.7 The Developer shall prepare permanent and temporary electrical designs for the Construction Work, which shall include the electrical and power requirements for the lighting, Intelligent Transportation Systems (ITS), traffic signals, landscaping, Cover, pump stations, and all other electrical devices that, in each case, form part of the Construction Work.

4.2.8 Utility Services

a. Developer shall be responsible for all costs of Utility services, including costs for power, communications, natural gas, and water service associated with the Work and the Developer's operations such as maintenance facilities, office facilities, or other similar facilities under Developer's control necessary for the Work.

b. The Developer shall perform all Utility Work necessary to maintain existing or establish new Utility services for lighting, ITS, traffic signals, landscaping, Cover, pump stations, and all other electrical devices that, in each case, form part of the Work. All cost charges from the power service provider, and all necessary materials, including meter (if required), labor, and coordination required to maintain existing or establish new Utility services shall be included in the Work.

c. The Developer shall be responsible for the coordination of power source work to be performed by Xcel Energy. The Developer shall contact the Xcel Energy Builder's Call Line at 1-800-628-2121 or by email at bclco@xcelenergy.com to request, and process to completion, the required coordination to establish the Utility service for lighting, ITS, traffic signals, landscaping, Cover, pump stations, and other electrical devices that, in each case, form part of the Work.

4.2.9 The Developer shall obtain approval of the power service design from the Utility service provider and coordinate and meet all requirements as specified by the Utility service provider for the complete and operational power service to all required locations. All power connections to devices shall include a quick-disconnect.

4.2.10 Utility Work

Unless stated otherwise, Utility Work includes, but is not limited to, the following activities:

a. Verification of all Utilities, as identified or described in the Utility Data, and the identification of all other Utilities, including in each case all necessary potholing located within the Construction Work or otherwise impacted by the Construction Work;

b. Development and updating of the Utility Matrix;

c. Preparation and execution of Utility No-Conflict Closeout Forms;

d. Negotiation, preparation, and execution of the Utility Work Order for each Utility Relocation and Utility service, including preparation and provision of such written information concerning the Construction Work (such as reports, plans and surveys) as required to fully identify the extent of such Utility Relocation and as reasonably requested by the Department and the Utility Owner;

e. Preparation of Utility Relocation design for each Utility Relocation of a Public Utility and obtaining design acceptance from the Publicly Owned Utility by obtaining its execution of a DRAL;

f. Construction and Inspection of Utility Relocations of Public Utilities, including Service Lines, Utility services, temporary Utility Relocations, and obtaining construction acceptance from the Publicly Owned Utility by obtaining its execution of a CRAL;

g. Remove or flow-fill abandoned existing Public Utilities that are greater than 12 inches in diameter;

h. Extension of all existing Utility casing to the limits required by the CDOT *Standard Specifications*. The Developer shall be responsible to extend casings for Publicly Owned Utilities in connection with the Project. The Developer shall be responsible to coordinate with the Private Utility Owners to locate and extend existing casings in connection with the Project;

i. Review of the Utility Relocation design for each Private Utility and execution of a DRAL certifying that the design of each Utility Relocation is compatible with the Construction Work (except as such process is specifically modified by the URA between CDOT and Zayo Group, LLC);

j. Reimbursement to Private Utility Owners in accordance with the terms of the applicable URA for design costs incurred by such Private Utility Owners in respect of Utility Relocations;

k. Inspection of the Utility Relocation construction for each Private Utility and execution of a CRAL certifying that the construction of each Utility Relocation is compatible with the Construction Work;

l. Reimbursement to Private Utility Owners in accordance with the terms of the applicable URA for Utility Relocation costs incurred by such Utility Owners in performing Utility Relocations within an easement owned by the Private Utility Owner;

m. Reimbursement to Utility Owners for the acquisition of replacement easements required for Utility Relocations in respect of existing easements shown on the Right-of-Way Exhibits provided in Schedule 10B (*Contract Drawings*).

n. Resurfacing and restriping of streets and parking areas, and reconstruction of curb and gutter and sidewalks where necessary due to Utility Relocations performed by the Developer or performed by a Private Utility Owner, within the Utility Relocation limits;

o. Compliance with its obligations under Schedule 14 (*Strategic Communications*) insofar as such obligations relate to the Utility Work;

p. Performance of traffic control for Utility Work performed by the Developer, or Utility Relocations performed by a Private Utility Owner, within the Utility Relocation limits;

q. Provision of survey coordinates, including field staking as necessary for design and construction of Utility Work performed by the Developer or for Utility Relocations performed by a Private Utility Owner;

r. Performance of Incidental Utility Work;

s. Responsibility for all costs associated with Utility services;

t. Provision of As-Built plans, including x, y and z coordinates for all completed Utility Work Orders;

u. Incorporation of Utility as-built plans into Project plans base file for inclusion in all subsequent plan submittals;

v. Identification and removal of abandoned existing Private Utilities as required to complete the Construction Work; and

w. All necessary Construction Work associated with Utility Work.

4.2.11 Exclusions From Utility Work

Utility Work excludes the following activities:

a. Issuance of any Permit to any Utility Owner;

b. Provision and maintenance of any insurance in excess of the Developer's obligations under the Agreement; and

c. Design and construction of Utility Relocation of Private Utilities, including Service Lines and temporary Utility Relocations, unless identified as a Requested Relocation.

4.2.12 Developer's Responsibility to Perform

a. Without prejudice to the Developer's rights under the Agreement as a result of the occurrence of a Supervening Event, the Developer shall perform all activities included in the Utility Work with respect to each impacted Utility regardless of the following:

i. Whether or not the Utility was identified in the Utility Data or, if identified, whether or not the Utility was accurately identified; or

ii. The type of action, if any (e.g., Utility Relocation, Protection in Place), feasibility, estimated duration of Construction Work, or any other characteristic of any Utility Relocation concept(s) proposed for the Utility in the Utility Data.

b. The Developer shall be responsible for coordinating with Utility Owners in relation to the performance of all Utility Work by the Developer and the performance of all work relating to Utility Relocations by Utility Owners.

4.2.13 Utility Owners

a. Except as otherwise provided in the applicable URA or Utility Work Order, all Utility Work performed by the Developer shall comply with the relevant Utility Relocation Standards. The Developer shall obtain all such written specifications, standards of practice, and construction methods and other information and materials constituting the Utility Relocation Standards from the Utility Owners. In the event of a conflict between the requirements of the Utility Owner set out in the relevant Utility Relocation Standards or the applicable URA and the requirements of the Agreement, the Department will determine, in its sole discretion, which requirement governs. The Developer is responsible for the resolution of any unresolved ambiguity prior to proceeding with any Utility Work.

b. Utility Relocations to be performed by the Developer for any existing Utilities shall be designed and constructed to provide service at least equal to that provided by the existing Utility, unless the Utility Owner approves a lesser replacement.

c. In performing the Utility Work, the Developer shall ensure that all Utility Work results in Utilities being located in a manner to allow future Utility maintenance to be performed by the relevant Utility Owner without disruption to the operation or maintenance of the I-70 Mainline and related facilities.

d. Utilities shall not be placed longitudinally within the I-70 Mainline, nor shall Utility Relocations be allowed within the I-70 Mainline, except as Approved by the Department .

4.3 Identification of Utilities

4.3.1 Department-Supplied Information

The Department has completed an initial Utility investigation and has identified the Utilities that may be impacted by the Construction Work. The Department has not performed a complete investigation of Service Lines or location and size of existing casings. The results of the Department's investigations are indicated in the Utility Data.

4.3.2 Developer's Investigations

a. The Developer shall identify and confirm the existence, exact location, size, and type of all Utilities located within the Site or that might otherwise be impacted by the Construction Work, whether or not such Utilities are shown in the Utility Data, including all potentially impacted Service Lines. Such actions shall include making diligent inquiry at the offices of the Utility Owners, consulting public records, and conducting field studies (such as subsurface Utility engineering), as appropriate, taking into consideration the possibility that Utility Owners may provide inaccurate or inexact information with regard to their Utilities.

b. If the Developer identifies any Utility during such investigations or otherwise during the performance of the Construction Work that was not identified in the Utility Data, the Developer shall notify the Department and the relevant Utility Owner immediately upon discovery. Thereafter, the Department, the Developer, and the Utility Owner shall either execute a Utility No-Conflict Closeout Form in respect of such Utility, or execute a Utility Work Order in respect of such Utility, including agreement as to whether the Utility Owner or the Developer shall be required to perform the relevant Utility Relocation.

c. The Developer shall, at least monthly, and otherwise upon the Department's reasonable request (a request shall be deemed to be reasonably made by the Department if the relevant Utility Owner has requested such information in accordance with the terms of the relevant URA), deliver to the Department and Utility Owner the updated Utility Matrix, which shall be updated and expanded to include the following information (unless otherwise agreed between the Parties):

i. The relevant number and execution date of each executed Utility Work Order;

ii. Each Utility No-Conflict Closeout Form execution date;

iii. Each DRAL execution date;

iv. Each CRAL execution date;

v. Completed as-built plans delivery date, to or by the Developer, as applicable; and

vi. Identification of all changes made since the immediately prior version of Developer's Utility Matrix.

4.3.3 Utility Work Orders

a. The Utility Owner, the Developer, and the Department, in that order, shall execute a Utility Work Order prior to commencement of any Utility Work to be performed by the Developer or Utility Relocation to be performed by a Utility Owner. The Developer may prepare a single Utility Work Order covering more than one Utility Relocation, Utility Betterment, or Requested Relocation with the consent of the Department and the relevant Utility Owner.

b. Prior to executing any Utility Work Order, the Developer and the Department shall meet with the relevant Utility Owner to negotiate the relevant draft Utility Work Order, including the following:

i. In accordance with the procedures set out in the applicable URA, the scope of work, the implementation schedule, and any exhibits and any other matters required to be agreed pursuant to the URA; and

ii. In accordance with the remaining provisions of this Section, cost and payment responsibility.

c. The costs for Construction Work performed by the Developer under a Utility Work Order for Utility Betterments or Requested Relocations shall be negotiated between the Developer and the Utility Owner. If it is agreed that the Utility Owner will reimburse the Developer for any costs in connection with Utility Work, the Developer shall provide a cost estimate to the Utility Owner in accordance with the Utility Owner's standard practice and with the requirements of the applicable URA, and shall submit such estimate to the Department. After cost estimate Approval by the Utility Owner and the Department, the estimate shall be incorporated into the applicable draft Utility Work Order. If a Utility Owner is responsible for the payment of any amount of the cost of a Utility Betterment or Requested Relocation pursuant to a Utility Work Order, payment shall be made by the Utility Owner to the Developer in accordance with the terms of the applicable URA. The Department shall not be responsible for the payment of any amount with respect to a Utility Betterment or Requested Relocation other than as expressly provided for in the relevant URA or in the relevant Utility Work Order.

d. The costs for Construction Work in respect of Utility Relocations within a Private Utility Owner permanent easement, or any Utility Relocation design work performed by a Private Utility Owner under a Utility Work Order, shall be negotiated between the Developer and the Private Utility Owner. If it is agreed that the Developer will reimburse a Private Utility Owner for any such costs, the Developer shall obtain a definitive cost estimate from the Private Utility Owner in accordance with the requirements of the applicable URA or the Private Utility Owner's standard practice, and shall submit such estimate to the Department. After cost estimate Approval by the Developer and the Department, the estimate shall be incorporated into the applicable Utility Work Order. If the Developer is responsible for the payment of any such costs pursuant to a Utility Work Order, that amount shall be paid to the Private Utility Owner in accordance with the terms of the applicable URA.

e. For Utility Betterments and Requested Relocations, the draft Utility Work Order shall include the direct impact of such Utility Work Order on the performance of the Construction

Work and the Developer's ability to follow the Project Schedule, in each case taking into account the Developer's obligations under the Agreement, and such other information as the Department may reasonably require.

f. On the basis of the meetings held in accordance with this Section, the Developer shall submit each draft Utility Work Order to the Department for Acceptance.

g. The Developer shall submit each Accepted draft Utility Work Order to the Utility Owner for approval and itself execute the Utility Work Order.

h. The Developer shall submit the Utility Owner approved Utility Work Order to the Department for Approval, in accordance with the applicable URA.

i. After Approval of a Utility Work Order the Developer shall thereafter perform the Utility Work for which it is responsible pursuant to such Utility Work Order as part of the Construction Work.

j. The Developer shall propose revisions to any Utility Work Order if and when necessary in accordance with the terms of the applicable URA. Such a revised Utility Work Order shall be drafted and executed in accordance with the same procedures applicable to the drafting, Approval and execution of the original Utility Work Order under this Section.

4.3.4 Damage to Utilities Caused by the Developer

a. The Developer shall be responsible for any damage caused by the Developer or any Developer Related Entities to Utilities, property (whether personal or real), equipment, or facilities of Utility Owners or their Affiliates.

b. The Developer shall immediately notify the affected Utility Owner of any Utility damaged by the Developer during performance of the Construction Work, and copy the Department, for Information, no later than seven days following Utility Owner notification. Promptly after the Developer's discovery of such damage, or the Developer's receipt of notice of any such damage from the Utility Owner or from any other source:

i. The Developer shall repair the damage to the Utility Owner's satisfaction; or

ii. At the Utility Owner's election, the Utility Owner may make such repairs at the Developer's expense. The Developer shall make payment to a Utility Owner within 60 Calendar Days after receipt of the Owner's invoice.

4.3.5 Multiple Moves

The Developer shall be responsible for all costs incurred by the Department, the Developer, or a Utility Owner to subsequently relocate any Utility already relocated to accommodate the Construction Work.

4.4 Utility Coordination

4.4.1 General

The Developer shall be responsible for all coordination with affected Utility Owners to accomplish each Utility Relocation in accordance with the applicable URA. In the discharge of its coordination responsibilities, the Developer shall:

a. Keep Utility Owners fully informed of schedules with regard to Utility Work. The Developer shall provide to the Utility Owners, as soon as practicable, an estimated schedule for the relevant Utility Work and shall notify the Utility Owners of any changes to the schedule as soon as practicable;

b. Keep Utility Owners fully informed of changes that affect their Utilities;

c. Consider, to the extent practicable, Utility Owners' needs for the allocation of resources to perform their respective Utility Work in a timely manner;

d. Keep Utility Owners involved in making decisions that affect their Utilities so Utility Owners are able to provide uninterrupted service to their customers, or to be subject to the least interruption practicable as approved by the Utility Owner; and

e. Avoid multiple Utility Relocations of the same Private Utility.

4.4.2 Utility Meetings

a. Between the Developer and Utility Owners

In addition to any meetings or negotiations required in accordance with the Agreement, after execution of a Utility Work Order, the Developer shall schedule regular meetings with the relevant Utility Owner to discuss the progress of the Utility Work and any Utility Relocation being performed by the Developer or the Utility Owner respectively, pursuant to the terms of the Utility Work Order. The Developer shall not unreasonably deny any request by a Utility Owner to meet regarding any Utility Work being performed by the Developer or Utility Relocation being performed by the Utility Owner. The Developer shall provide the Department with at least seven Calendar Days prior notice of any meeting with a Utility Owner, unless a shorter notice period is agreed by the Department or is reasonably necessary under the circumstances and the Department shall be entitled, at its discretion, to attend any such meeting.

b. Between the Department and the Developer

i. The Developer and the Department shall meet at least monthly and otherwise as reasonably requested by the other Party to discuss and resolve matters relating to the Utility Work being performed by the Developer or Utility Relocation being performed by the Utility Owner; and

ii. The Party proposing a meeting shall provide the other Party with a minimum of five Working Days prior notice of any proposed meeting, unless a shorter notice period is agreed or reasonably necessary under the circumstances.

c. Minutes

The Developer shall produce minutes of all such meetings with Utility Owners and/or the Department and shall distribute copies of the minutes to the Department and, when such meetings were attended by a Utility Owner, to the relevant Utility Owner, not later than four Working Days after each meeting.

4.4.3 Schedules

a. The Developer shall allow appropriate time periods for the performance of all tasks shown on each Utility Work Order, including design, material procurement and construction whether performed by the Developer or Utility Owner.

b. All schedules and deadlines for the design and construction of Utility Work or Utility Relocation Work to be performed by the Utility Owner set forth in the Utility Work Orders shall prevail over any estimated times noted in the Utility Data.

4.4.4 Notices

a. To Utility Owners

i. The Developer shall issue all notices in writing to the Utility Owners required to be submitted under the URAs, with copies submitted to the Department, for Information, no later than seven Calendar Days after the issuance to the Utility Owner.

ii. Notice shall be given to respective Utility Owners when the Developer is performing Construction Work adjacent to their Utilities. The Developer shall be solely responsible for and liable for any damage to any Utilities that are damaged due to the Work.

b. To the Department

i. The Developer shall be responsible for verifying progress on a Utility Relocation performed by the Utility Owner and for notifying the Department should the Developer have cause to believe that the Utility Owner will not meet the specified time frame(s) in the Utility Work Order. Without prejudice to any obligations of the Developer arising as a result of the occurrence of any Supervening Event, the Developer shall provide such written notice to the Department immediately after coming aware of any such delay.

ii. If the Utility Owner is performing a Utility Relocation that requires a Permit, the Developer shall verify with the Department that the required Permit has been obtained and is being complied with. If the Developer determines that the Utility Owner does not have the required Permit, or is in violation of the terms and conditions of such Permit, the Developer shall provide written notice to the Department immediately after making such determination.

c. To Utility Notification Center of Colorado

The Developer shall arrange for the Utility Notification Center of Colorado (UNCC) to provide software and training for the Developer to order call tickets to have Utility field locates performed. The Developer shall contact UNCC to make arrangements for the training. This will allow the Developer to order its own call tickets via e-mail.

4.5 **Failure of Utility Owner to Cooperate or Timely Perform**

4.5.1 The Developer shall use Reasonable Efforts to obtain the cooperation of each Utility Owner as necessary for carrying out the Utility Work. Without prejudice to any obligations of the Developer arising as a result of the occurrence of any Supervening Event, the Developer shall notify the Department immediately if:

a. The Developer becomes aware that any Utility Owner is not cooperating in identifying Utilities, negotiating or executing Utility Work Orders, performing of any Utility Relocation, approving any Utility Work, or delivering DRALs or CRALs;

b. A Utility Owner fails to complete design and/or any Utility Relocation for which it is responsible on or before the deadline established in the applicable Utility Work Order;

c. Based on the progress made by the relevant Utility Owner, the Developer believes that there is a possibility that the Utility Owner will not complete a Utility Relocation being undertaken by the Utility Owner or any other Utility Work as required pursuant to a Utility Work Order, to the extent and in the manner shown on the Utility Drawings, within the time limits set out in the applicable Utility Work Order; or

d. In the case of each (a), (b), or (c), advising the Department whether the Developer has complied in all respects with the requirements of this Section including compliance with the applicable URA and the applicable Utility Work Order with respect to the relevant portion of the Utility Work.

4.5.2 After delivery of any such notice, the Developer shall continue to diligently pursue the Utility Owner's cooperation and shall assist the Department in any attempts to reach a solution through the dispute resolution procedure outlined in the applicable URA. The Developer shall document any incurred costs as a direct result of the Utility Owner's failure to cooperate or perform its obligations under the applicable URA in a timely manner.

4.5.3 In the event that the Department pursues legal action against a Utility Owner pursuant to C.R.S. § 43-1-1411, the Developer shall cooperate as reasonably requested by the Department in connection with such lawsuits, including causing Developer-Related Entities to act as witnesses in such lawsuits and to provide information, reports, graphs, photos, plans, renderings, and similar materials to the Department's legal counsel at the Developer's expense.

4.6 **Utility Work Procedure**

4.6.1 Utility Agreements

a. The Reference Documents include URAs with each Utility Owner whose Utilities are known to, or may be, affected by the Construction Work.

b. If the Developer identifies Utility Work that is required in relation to a Utility owned by a Utility Owner that has not entered into a URA with the Department in respect of the Project, the Department may enter into such an agreement with such Utility Owner. The Developer shall not be a party to any such agreement. The Department (and not the Developer) shall be responsible for drafting and negotiating the agreement, provided that:

i. To the extent reasonably requested by the Department, the Developer shall provide assistance to the Department in connection with such negotiations, including by the provisions to the Department of information in the Developer's possession, relating to Utilities owned by the relevant Utility Owner that will, or may be, impacted by the Project; and

ii. Until such agreement has been executed by the Utility Owner and the Department, the Developer shall be responsible for coordinating with such Utility Owner as if it had executed such an agreement.

4.6.2 Utility As-Built Plans

a. Where the Utility Owner performs the Utility Work, the Utility Owner is required in accordance with the terms of its URA to provide as-built plans of the Utility Relocation to Department and to the Developer, not later than 90 Calendar Days after execution of the relevant CRAL. The as-built plans may be in the form of redlining changes that deviate from the Accepted DRAL plans or labeling the accepted DRAL plans "constructed per plan." The Developer shall show the Utility as-built information on its final As-Built drawings; and

b. Where the Developer performs the Utility Work, the Developer shall provide as-built plans of the Utility Relocation to the Department and the Utility Owner but in any event not later than 90 Calendar Days after execution of the relevant CRAL. The As-Built plans may be in the form of redlining changes that deviate from the Accepted DRAL plans or labeling the accepted DRAL plans "constructed per plan." The Developer shall show the Utility s-built information on its final As-Built drawings.

4.7 **Deliverables**

4.7.1 For all deliverables required under this Section, the Developer shall also provide, at a minimum and as applicable, the following:

a. Utility Plan Sheet;

b. ROW Plans;

c. Most current roadway and drainage plans;

d. Utility exhibits (including existing and proposed Utility locations);

e. Cost estimate (if applicable); and

f. x, y and z coordinates of Utility Relocations.

4.7.2 For all Work Orders in respect of a Utility Relocation of a Public Utility, the Developer shall prepare and include the following wet Utility Plan deliverables in its submittal:

a. Plan View;

i. All Utilities shall be accurately shown and labeled with appropriate Utility identification number; and

ii. Plans shall include existing topography, property boundaries, drainage facilities, structures, traffic features and all other existing and proposed facilities.

b. Profiles;

i. All Utilities shall be accurately shown and labeled with appropriate Utility ID number;

ii. Provide profiles for all existing and proposed Utility lines larger than eight inches. Include the Utility ID number from plan view sheets, station and offset, elevations, sizes, material, existing and proposed finished grade line; and

iii. All clearances between drainage facilities and Utilities shall be clearly labeled.

c. Accepted Construction Plans for wet Utilities included with the DRAL;

d. Plans for all Utility related facilities for the Construction Work in a format that follows the CDOT *CADD Manual*; and

e. All other applicable plans with all changes to design.

4.7.3 Utility As-Built Documents

All information as described in Table 4-1 shall be updated based on As-Built survey and submitted to the Department for Acceptance.

4.7.4 At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the timeframes specified:

Table 4-1 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Developer's Utility Matrix	Information	Monthly or at the Department's request
Utility No-Conflict Closeout	Acceptance	Prior to RFC Documents
Utility Relocation cost estimate	Approval	Prior to RFC Documents
Draft Utility Work Order	Acceptance	Prior to RFC Documents
Utility Work Order	Approval	Prior to RFC Documents
DRAL	Acceptance	Prior to RFC Documents
CRAL	Acceptance	Prior to RFC Documents
Utility As-Built plans	Acceptance	90 Calendar Days after execution of CRAL
Wet Utility Plan submittal	Acceptance	Prior to RFC Documents
Meeting minutes	Acceptance	Four Calendar Days after meeting
Copy of written notice to Utility Owners	Information	Seven Calendar Days after Utility Owner notification
Written notice of Utility Owner not meeting Work Order time frame	Information	Prior to RFC Documents
Written notice of Utility Permit violation	Information	Prior to RFC Documents
Written notice of failure of Utility Owner to cooperate or timely perform	Information	Prior to RFC Documents

4.8 **Appendices**

Appendix A Utility No-Conflict Closeout Form

Appendix B Form of Utility Work Order

Appendix C Form of Design of Relocation Acceptance Letter (DRAL)

Appendix D Form of Construction of Relocation Acceptance Letter (CRAL)

Appendix A
Utility No-Conflict Closeout Form

This Utility No-Conflict Closeout Form ("No-Conflict Form") is executed by the Utility Owner and the CDOT Developer in connection with the I-70 East Project Utility Relocation Agreement ("URA") entered into by the Utility Owner and CDOT. Unless the context clearly otherwise requires, initially capitalized terms shall have the meaning prescribed to them in the URA.

A fully-executed No-Conflict Form indicates the Parties' concurrence that, as of the Project plans current at the date of Utility Owner's execution hereof, no Relocation is required for Utility Owner's Utility referenced herein. Utility Owner and the CDOT Developer acknowledge that future modifications to the Project may require Relocation of the referenced Utility in accordance with the URA. Two originals shall be executed and a copy shall be forwarded to CDOT by the CDOT Developer.

Utility Owner	
Utility Identification No.:	
Location	
Comments (attach pages as necessary)	

FOR UTILITY OWNER

By: _____ Date: _____
Name:
Title:

FOR CDOT DEVELOPER

By: _____ Date: _____
Name:
Title:

If this form is not signed by the Utility Owner, the Utility Owner shall state below its basis for disagreement with the No-Conflict designation for this Utility:

_____

_____

_____

_____

_____

(attach pages as necessary)

Appendix B
Form of Utility Work Order

Utility Owner:			
Utility Identification No.:			
Work Order No.:		Work Order Revision No.:	
Work Breakdown Structure No.:			
LOCATION:			
DESCRIPTION:			
OPERATING RIGHTS:			
DESIGN	☐ No Design Required		
Performing Party	☐ Contractor	☐ Owner	
Responsible Party	☐ Contractor	☐ Owner	
Contractor pays Owner	Lump Sum:	Actual Cost Not to Exceed:	
Owner pays Contractor	Lump Sum:	Actual Cost Not to Exceed:	
Comments			
CONSTRUCTION	☐ No Construction Required		
Performing Party	☐ Contractor	☐ Owner	
Responsible Party	☐ Contractor	☐ Owner	
Contractor pays Owner	Lump Sum:	Actual Cost Not to Exceed:	
Owner pays Contractor	Lump Sum:	Actual Cost Not to Exceed:	
Comments			
CONSTRUCTION INSPECTION	☐ No Construction Inspection Required		
Performing Party	☐ Contractor	☐ Owner:	
Responsible Party	☐ Contractor	☐ Owner:	
Contractor pays Owner	Lump Sum:	Actual Cost Not to Exceed:	
Owner pays Contractor	Lump Sum:	Actual Cost Not to Exceed:	
Comments			
PROPERTY INSPECTION	☐ No Property Acquisition Required		
Performing Party	☐ Contractor	☐ Owner:	
Responsible Party	☐ Contractor	☐ Owner:	
Contractor pays Owner	Lump Sum:	Actual Cost Not to Exceed:	
Owner pays Contractor	Lump Sum:	Actual Cost Not to Exceed:	
Comments			

SCHEDULE (THIS WORK ORDER ONLY)

Design	**Construction**
Start Date: _____	Start Date: _____
Completion Date:	Completion Date:
Comments:	

CHANGE ORDER

If this section is signed by the CDOT representative, then this Work Order will function as a Change Order.

_____

CDOT Representative Date

WORK ORDER TERMS AND CONDITIONS

SCOPE OF WORK ORDER. This Work Order is entered into by and among Utility Owner and CDOT, and, where applicable, the CDOT Developer in order to implement in part the URA identified herein, as the same may be amended from time to time, and which is incorporated herein by this reference. All work undertaken pursuant to this Work Order shall be performed in accordance with the requirements of the URA, which shall govern to the extent of any conflict between its terms and the terms of this Work Order. Relocation Standards specifically identified in the URA are incorporated herein by this reference. Unless otherwise defined herein, all initially capitalized terms and conditions shall have the meaning prescribed to them in the URA.

WORK ORDER ATTACHMENTS. This Work Order and any attachments hereto contain information specific to the Relocation to be performed hereunder. Attached and/or referenced Relocation Standards are incorporated herein by this reference and shall be considered a part of this Work Order. This Work Order governs only the Utility Work specifically identified herein and shall be conclusive as to all matters represented herein.

ORDER OF EXECUTION. This Work Order shall be executed first by Utility Owner, then by the CDOT Developer (if applicable) and finally by CDOT.

IN WITNESS WHEREOF, CDOT, the Utility Owner, and where applicable, the CDOT Developer have executed this Work Order, which shall be effective as of the date of the CDOT's signature.

Utility Owner: _____
By: _____
Print Name: _____
Title: _____
Date: _____

CDOT Developer: _____
By: _____
Print Name: _____
Title: _____
Date: _____

CDOT: _____
By: _____
Print Name: _____
Title: _____

Date: _____

Utility Identification No.:

SECTION A	SCOPE

SECTION B	REQUIRED PERMITS

Permit Type	Permit Responsibility

SECTION C	LIST OF ATTACHMENTS

☐ Owner Design Sheet _____
☐ Project Design Sheet _____
☐ Cost Estimate _____
☐ Property Rights _____
☐ Other: _____

Appendix C
Form of Design of Relocation Acceptance Letter (DRAL)

This DESIGN OF RELOCATION ACCEPTANCE LETTER ("DRAL") is executed by the non-Designing Party in connection with the I-70 East Project Utility Relocation Agreement (URA), entered into by the Utility Owner and CDOT. Execution of this DRAL indicates the non-Designing Party's acceptance and approval of the design of the Relocation, as attached to this DRAL, performed and completed by the Designing Party. Unless otherwise defined herein, initially capitalized terms shall have the meaning prescribed to them in the URA. Two originals shall be executed and a copy shall be forwarded to CDOT by the CDOT Developer.

Utility Owner: _____

Utility Identification No.: _____

Work Order No.: _____ Work Order Date: _____

Work Order Rev. No.: _____ Rev. Date: _____

Designing Party: _____

Now, therefore, the non-Designing Party executes this DRAL to indicate that it has reviewed the design of the Relocation completed by the Designing Party and has found the design of the Relocation to have been designed in accordance with the non-Designing Party's Relocation Standards duly provided to the Designing Party:

Non-Designing Party

By: _____
Name: _____.
Title: _____.
Date: _____

☐ The non-Designing Party declines execution of this DRAL at this time for the following reasons:

_____

_____

_____ (attach pages as necessary)

☐ The Constructing Party may proceed with construction of the Relocation.

_____

Appendix D
Form of Construction of Relocation Acceptance Letter (CRAL)

This CONSTRUCTION OF RELOCATION ACCEPTANCE LETTER ("CRAL") is executed by the non-Constructing Party in connection with the I-70 East Project Utility Relocation Agreement (URA) entered into by the Utility Owner and CDOT. Execution of this CRAL indicates the non-Constructing Party's Inspection and acceptance of the construction of the Relocation performed and completed by the Constructing Party. Unless otherwise defined herein, initially capitalized terms shall have the meaning prescribed to them in the URA. Two originals shall be executed and a copy shall be forwarded to CDOT by the CDOT Developer

The construction of the Relocation inspected and accepted by execution hereof is described below:

Utility Owner: _____

Utility Identification No.: _____

Work Order No.: _____ Work Order Date: _____

WO Revision No.: _____ WO Revision Date: _____

Constructing Party:_____

Now, therefore, the non-Constructing Party executes this CRAL to indicate that it has inspected the construction of the Relocation completed by the Constructing Party and has found the construction of the Relocation has been performed in accordance with the Relocation Plans:

NON-CONSTRUCTING PARTY

By: _____

Name: _____

Title: _____

Date: _____

☐ The non-Constructing Party declines execution of this CRAL at this time for the following reasons:

_____

_____

_____

_____

_____

(attach pages as necessary)

5. SURVEY

5.1 General

The Developer shall be responsible for the surveying Activities necessary to support the Construction Work, including ongoing operations and maintenance.

5.2 Applicable Standards

All Construction Work required to be performed by the Developer pursuant to this Section shall comply with Schedule 10A Applicable Standards and Specifications, the relevant requirements listed in this Section, and Law related to surveys.

5.3 Administrative Requirements

5.3.1 Project Survey Coordinator

The Developer shall designate a Colorado registered professional land surveyor as the Project Survey Coordinator. The Project Survey Coordinator shall be responsible for all survey Activities required to be carried out by the Developer under the Project Agreement, including directing and reviewing all such Activities, being the point of contact for all such Activities and supervising the carrying out of such Activities.

5.3.2 Supplied Survey Data

a. The survey control point information completed by the Department is included in the Supplied Survey Data.

b. Survey and mapping information completed by the Department is provided in Schedule 29 Reference Documents. The Developer may utilize the Supplied Survey Data, at its discretion, and shall be responsible to conduct additional surveys necessary in accordance with this Section. The Developer shall form its own interpretation of the existing survey data included as to its suitability and sufficiency for the Developers' detailed design.

c. The Developer shall submit a Supplied Survey Data verification letter including records of relevant survey data verification, to the Department, for Information, within 60 Calendar Days after issuance of Notice to Proceed (NTP) 1.

d. For reference only and subject always to Section 3 of the Project Agreement, Table 5-1 provides a description of the survey and mapping information provided by the Department.

Table 5-1 Supplied Survey and Mapping Information

Survey and Mapping Information	Description of Data
I-25 to Sand Creek	Obtained from 2013 stereo aerial photography for all visible features in the photography consistent with 1"=50' mapping as described in the CDOT *Survey Manual*. Planimetrics are formatted per the CDOT *CADD Manual* in the Bentley Microstation environment.
Sand Creek to Airport Boulevard	Obtained from 2014 stereo aerial photography for all visible features in the photography consistent with 1"=50' mapping as described in the CDOT *Survey Manual*. Planimetrics are formatted per the CDOT *CADD Manual* in the Bentley Microstation environment.
Union Pacific Railroad (UPRR) and 46th Avenue: Brighton Boulevard to Garfield Street (under viaduct)	Data obtained in 2013 using a combination of Global Positioning System (GPS), Total Station and High Definition Scanning (HDS) Survey. Field and mapping procedures achieve a 95 percent confidence level, as defined in the CDOT *Survey Manual*. Digital Terrain Model (DTM) is formatted per the CDOT *CADD Manual* in the Bentley Inroads environment. Planimetrics are formatted per the CDOT *CADD Manual* in the Bentley Microstation environment.
Storm and Sanitary Sewer Manhole Survey: Brighton Boulevard to Sand Creek and Storm Drain Outfalls	Obtained in 2014 from Real Time Kinematic (RTK) GPS and Total Station field survey, and consistent with the accuracy requirements described in Chapter Five of the CDOT *Survey Manual.*
Storm and Sanitary Sewer Manhole Survey – Sand Creek to Airport Road	Obtained in 2015 from RTK GPS and Total Station field survey, and consistent with the accuracy requirements described in Chapter Five of the CDOT *Survey Manual.*
Utility Locates Survey: Brighton Boulevard to Sand Creek and Storm Drain Outfalls	Obtained in 2014 from RTK GPS and Total Station field survey, and consistent with the accuracy requirements described in Chapter Five of the CDOT *Survey Manual.*
Utility Locates Survey: Sand Creek to Airport Road	Obtained in 2015 from RTK GPS and Total Station field survey, and consistent with the accuracy requirements described in Chapter Five of the CDOT *Survey Manual.*

5.3.3 Additional Survey Data

a. Without prejudice to Section 3 of the Project Agreement, the Developer shall be responsible for identifying the need for, and undertaking additional surveys required to produce, any Additional Survey Data that may be required for the Construction Work. The required information may include topographic surveys, survey of Utilities, and miscellaneous surveying as necessary to complete the Construction Work. All traffic control and Permits necessary to complete such surveys shall be the responsibility of the Developer.

b. The Developer shall obtain all necessary right-of-entry agreements to land and property outside the Right-of-Way (ROW).

c. Within 60 Calendar Days of the completed additional survey, the Developer shall submit the Additional Survey Data to the Department for Information.

5.4 Survey Requirements

5.4.1 Preservation of Survey Markers and Monuments

The Developer shall:

a. Preserve all survey markers, including City and County of Denver (CCD) range point markers, and monuments;

b. Inform the Department (and the relevant Local Agency, if affected) in the event that the Developer identifies a survey marker or monument that is in a position that will interfere with the performance of the Construction Work and, in such cases, accurately record the position of any marker or monument prior to disturbance;

c. Submit documentation to the Department (and, if affected, the Local Agency) relating to the preservation and/or monumentation, as applicable, of survey monuments. Documentation submitted to the Local Agency shall meet the relevant Local Agency requirements;

d. Immediately notify the Department (and, if affected, the Local Agency) in the event that any CDOT survey monuments or CCD range point markers are at risk of being destroyed, or are lost or destroyed, during the performance of the Construction Work;

e. Assume that the Local Agency affected will send a new marker disk to the Developer, which has been properly stamped, together with instructions for establishment of the new marker, failing which the Department will provide a new marker disk;

f. The Developer shall set the new marker under the direct supervision of the Project Survey Coordinator or other Colorado registered professional land surveyor and, where required by Applicable Law, shall bear the registration number of the responsible professional land surveyor; and

g. The Developer shall coordinate with all applicable Local Agencies that will or may be affected by the performance of the Construction Work. The Developer shall protect and restore any such monuments, as required, to complete the Construction Work.

5.4.2 Survey Records Report

a. The Developer shall prepare, maintain and submit to the Department for Information, a Survey Records Report including but not limited to survey documents, records, field notes, drawings, and calculations;

b. All survey records shall be neat, legible, accurate, and maintained by the Developer in a neat and orderly manner;

c. The Project Survey Coordinator shall be required to sign and seal survey documentation in accordance with applicable Law;

5.4.3 Control Surveys

a. The Developer shall be responsible for planning, scheduling, and performing control surveys and monumentation as necessary to maintain and supplement the project control network for the Construction Work.

b. The Developer shall submit to the Department, for Information, a revised project control diagram showing all modifications to the Department's project control network.

5.4.4 Railroad Associated Surveys

The Developer shall plan, schedule and perform staking and construction layout required for the Railroad Construction Work for the UPRR Crossing, UPRR Pepsi Lead Crossing, BNSF Crossing, and DRIR Crossing. Construction staking for Railroad Construction Work shall conform to the requirements of the applicable Railroad.

5.4.5 As-Built Surveys

a. The Developer shall plan, schedule, and perform all surveys required to document the location of As-Built features on the Project.

b. The Developer shall deliver the As-Built data, in InRoads Terrain Modeling Survey System (TMOSS) survey format, and survey records to the Department for Information prior to Final Acceptance. Errors and omissions found by the Department shall be corrected by the Developer and resubmitted.

5.4.6 Right-of-Way Monumentation

a. The Developer shall submit a ROW Monumentation Plan, for Information, to the Department, to document all ROW monuments and note any existing, destroyed, moved, replaced or new ROW monuments;

b. The Developer shall replace all ROW monumentation and/or CCD range point markers lost or destroyed during the progression of the Construction Work;

c. The Department will set new ROW monumentation for acquired properties.

5.5 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the timeframes specified:

Table 5-2 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Supplied Survey Data verification letter	Information	60 Calendar Days after issuance of NTP 1
Additional Survey Data	Information	Within 60 Calendar Days of completed additional survey
Documentation for the preservation or re-monumentation of any survey monument or marker	Information	Submit with As-Built documentation
Revised project control diagram	Information	Prior to Final Acceptance
Survey Records Report	Information	Prior to Final Acceptance
As-Built data and records	Information	Prior to Final Acceptance
ROW Monumentation Plan	Information	Prior to Substantial Completion

6. ROADWAY PAVEMENTS

6.1 General

6.1.1 The Developer shall be responsible for the design and construction of the I-70 Mainline and Local Agency Roadway pavements to meet the requirements and criteria specified in this Section.

6.1.2 Roadway pavement segments for CDOT Roadways are provided by the Department. The Developer shall be responsible for material mix designs and construction on these roadways to meet the requirements and criteria specified in this Section.

6.1.3 The pavement type for private roadways, accesses, and driveways shall be the same as the existing facility and comply with Local Agency requirements unless otherwise Approved by the Department.

6.2 Applicable Standards

6.2.1 All Construction Work required to be performed by the Developer pursuant to this Section shall comply with Schedule 10A Applicable Standards and Specifications, the relevant requirements listed in this Section, and Good Industry Practice.

6.2.2 The Developer shall design the I-70 Mainline pavements, including a combination of materials and layer thicknesses for the pavement structure, in accordance with the requirements of the CDOT *M-E Pavement Design Manual*. Pavement design thickness shall be determined in accordance with the AASHTO mechanistic-empirical (M-E) design procedure using AASHTOWare *Pavement M-E Design* software (formerly DARWin-ME™).

6.2.3 The Developer shall design the Local Agency Roadway pavements, including a combination of materials and layer thicknesses for the pavement structure, in accordance with Local Agency standards.

6.3 Design

6.3.1 Available traffic data is provided in the Reference Documents. The Developer shall conduct such additional traffic data collections as it determines necessary to complete its pavement designs.

6.3.2 The Developer is responsible for integrating the pavement designs with the design and construction of effective subsurface drainage and frost protection, including the provision of subdrains or any other drainage treatments.

6.3.3 The asphalt binder required shall be determined using LTPPBind. For CDOT Roadways use location-specific climate data assuming 98% reliability and slow conditions.

6.3.4 The I-70 Mainline pavement type may be either hot mix asphalt (HMA) or Portland cement concrete pavement (PCCP), provided that the selected pavement type shall be the same for the entire segment between Brighton Boulevard and Sand Creek; and the selected pavement type shall be the same for the entire segment between Sand Creek and I-225. The pavement structure shall be the same from edge of pavement to edge of pavement for both segments.

6.4 Pavement Design Reports and Pavement Designs

6.4.1 The Developer shall prepare and separate Pavement Design Reports for:

a. I-70 Mainline (to be submitted to the Department for Information); and

b. Local Agency Roadways pavement designs (to be submitted to the Local Agency for approval and the Department for Information).

6.4.2 As part of the Developer's Pavement Design Report submittals include the following:

a. The proposed typical pavement sections;

b. Geotechnical data and geotechnical design assumptions;

c. Material property assumptions;

d. Input and output from the pavement M-E design software; and

e. All traffic counts/calculations and assumptions used to determine the proper traffic data that was used.

6.4.3 CDOT Roadway pavement sections shall be constructed as shown in Table 6-1.

Table 6-1 Required Pavement Sections for CDOT Roadways (in)

Street	Aggregate Base Course Class 6	PCCP Reconstruction	HMA Reconstruction
Vasquez Boulevard	6.0	9.5	7.0
Colorado Boulevard	6.0	10.0	8.0
Quebec Street	6.0	13.5	12.0
I-270	6.0	14.5	13.0

Notes: 1 – New HMA pavements shall be constructed using a two inch stone matrix asphalt (SMA) top lift and lower lifts using S(100) PG 64-22. The maximum thickness of any HMA layer shall not exceed two inches.

6.4.4 The Developer shall prepare detour pavement designs and submit to the Department for Information.

6.5 Subsurface Investigations

6.5.1 Preliminary subsurface investigations are provided in the Reference Documents. The Developer shall conduct such additional subsurface investigations as it determines necessary to complete its pavement designs.

6.5.2 Geotechnical investigations completed by the Developer for the I-70 Mainline and CDOT Roadways shall comply with the requirements of the CDOT *Field Materials Manual* and the CDOT *Pavement Design Manual*. These shall be documented in a separate geotechnical investigation report and submitted to the Department for Information with the respective Pavement Design Report.

6.5.3 Geotechnical investigations completed by the Developer for Local Agency Roadways shall conform to Local Agency requirements. These shall be documented in a separate geotechnical investigation report and shall be submitted to the Local Agency and the Department for Information, with the Pavement Design Report.

6.6 Construction Requirements

6.6.1 The Developer shall be responsible for constructing Safety Edge on all pavements as specified in Schedule 10, Section 9 Roadway.

6.6.2 All PCCP segment shall conform to CDOT Standard Plan M-412-1.

6.6.3 The Developer shall provide for adequate sulfate resistance in all concrete supplied. Severity of potential exposure shall be determined by the Developer in accordance with the CDOT *Field Materials Manual*.

6.6.4 A minimum of 14 Calendar Days prior to the proposed use of any pavement in the Construction Work, a pre-paving conference shall be conducted.

6.6.5 Submission by the Developer, of pavement mix designs, and Acceptance by the Department, for CDOT Roadways and Local Agency Roadways for SMA, HMA, and PCCP, as well as Jointing Plans for PCCP for any roadway, is a condition for the initiation of any paving Construction Work.

6.6.6 Submission by the Developer, for Information, of pavement mix designs for the I-70 Mainline for SMA, HMA, and PCCP, is a condition for the initiation of any paving Construction Work.

6.6.7 In order to facilitate the addition of a Tolled Express Lane in each direction on the existing I-70 Mainline between Sand Creek and Chambers Road, the Developer shall meet the applicable Performance Requirements, as described in Schedule 11 Operations and Maintenance

Requirements. In the event that the existing pavement does not meet the applicable Performance Requirements, the Developer shall overlay the existing pavement to provide a safe and even surface across the entire width of the pavement. The overlay requirement shall not apply to the existing concrete pavement that begins approximately west of I-225. Within the concrete pavement segment the Developer shall evaluate the location of existing joint lines in the widening and restriping plan to ensure compliance with CDOT Standard Plan M-412-1.

6.6.8 For I-70 Mainline, PCCP shall extend to the limit of the physical gore on all ramps.

6.6.9 Roadway Pavement Materials

a. HMA mixes shall be subject to voids acceptance; and

b. If PCCP is selected, the following shall apply:

i. PCCP shall meet or exceed the minimum compressive or flexural strength requirements in accordance with the CDOT *Standard Specifications*;

ii. Joint design shall include tied inside and outside shoulders. Outside mainline shoulders shall include doweled transverse contraction joints;

iii. Longitudinal and transverse joint designs shall be compatible with lane and shoulder configurations. Longitudinal joints shall be placed adjacent to lane markings.

iv. The Developer shall texture the I-70 Mainline outside shoulders in accordance with the CDOT *Standard Specifications*. Final stamping stationing is not required.

v. SMA acceptance shall be based on gradation.

6.6.10 Pavement Smoothness

a. The pavement surface shall comply with the smoothness requirements set out in Table 6-2 and Appendix A Project Special Provisions within this Section.

b. Intersections constructed with PCCP shall be exempt from Table 6-2 requirements. However, the 10 foot straightedge requirements for both longitudinal and transverse smoothness shall still apply.

Table 6-2 Smoothness Requirements

Location	Pavement Smoothness Category
Flexible pavement	HRI Category II
Rigid pavement	HRI Category II
Overlay	HRI Category I
Detour	In accordance with Appendix A Project Special Provisions

6.7 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the specified timeframes:

Table 6-3 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Supplemental geotechnical investigation report – I-70 Mainline	Information	Submitted with Pavement Design Report
Supplemental geotechnical investigation report –CDOT Roadways	Information	Concurrent with Preliminary (30%) Level Plan Package
Supplemental geotechnical investigation report –Local Agency Roadways	Information	Submitted with Pavement Design Report
I-70 Mainline Pavement Design Report	Acceptance	Concurrent with Preliminary (30%) Level Plan Package
Local Agency Roadways Pavement Design Report	Information	Concurrent with Preliminary (30%) Level Plan Package
Paving Quality Control Plan	Information	At the pre-paving conference
SMA & HMA mix designs – I-70 Mainline	Information	Condition to the initiation of paving Construction Work
SMA & HMA mix designs – CDOT Roadways and Local Agency Roadways	Acceptance	Condition to the initiation of paving Construction Work
PCCP mix designs – I-70 Mainline	Information	Condition to the initiation of paving Construction Work
PCCP mix designs – CDOT Roadways and Local Agency Roadways	Acceptance	Condition to the initiation of paving Construction Work
Detour pavement mix design	Information	At the pre-paving conference
PCCP Jointing Plan – I-70 Mainline	Acceptance	Condition to the initiation of paving Construction Work
PCCP Jointing Plan – CDOT Roadways and Local Agency Roadways	Acceptance	Condition to the initiation of paving Construction Work

6.8 Appendices

Appendix A Project Special Provisions

Appendix A
Project Special Provisions

The following special provisions supplement or modify and take precedence over the Standard Specifications. The provisions of Appendix A to Schedule 10A Applicable Standards and Specifications apply to these Project Special Provisions.

PROJECT SPECIAL PROVISIONS

REVISION OF SECTION 105
CONFORMITY TO ROADWAY SMOOTHNESS CATEGORY OF HMA/SMA

Subsection 105.7 of the Standard Specifications is hereby revised as follows:

Delete Table 105-6 and replace with the following table:

Table 105-6A
HMA Pavement Smoothness (Inches/Mile) Half-Car Roughness Index

Pavement Smoothness Category	Corrective Work Required
I	When HRI > 72.0
II	When HRI > 67.0

REVISION OF SECTION 105
CONFORMITY TO ROADWAY SMOOTHNESS CATEGORY OF PORTLAND CEMENT CONCRETE PAVEMENT

Subsection 105.8 of the Standard Specifications is hereby revised as follows:

Delete Table 105-10 and replace with the following table:

Table 105-10A
PCCP Pavement Smoothness (Inches/Mile) Half-Car Roughness Index

Pavement Smoothness Category	Corrective Work Required
I	When HRI > 72.0
II	When HRI > 67.0

REVISION OF SECTION 106
QUALITY OF HOT MIX ASPHALT

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

Subsection 106.03 shall include the following:

The Developer is required to perform process control testing.

REVISION OF SECTION 304
AGGREGATE BASE COURSE CLASS 6

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

Subsection 304.02 shall include the following:

Materials for the base course shall be ABC Class 6 as shown in Subsection 703.03.

The ABC Class 6 must meet the gradation requirements and have a resistance value of at least 78 when tested by the Hveem Stabilometer method.

REVISION OF SECTION 304
AGGREGATE BASE COURSE CLASS 6 SPECIAL

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

Subsection 304.02 shall include the following:

Recycled Asphalt Pavement (RAP), the product of rotomill tailings or crushed asphalt pavement, utilized as ABC Class 6 (Special), shall be of uniform quality. The ABC Class 6 Special shall meet the gradation requirements for ABC (RAP) as specified in Section 20 (Revision of Sections 304 and 703). The material shall not contain clay balls, vegetable matter, or other deleterious substances. RAP is not required to meet the requirements of Subsection 703.03. ABC Class 6 Special shall only be allowed under PCCP.

Subsection 304.04 shall include the following:

The maximum density of RAP shall be determined in accordance with AASHTO T-180, Method A. The field moisture determination for correction to dry density shall be determined by oven or microwave drying. Moisture determination of RAP using a nuclear gauge will not be permitted.

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 HMA shall conform to the following:

Table 403-1

Property	Test Method	Value for Grading		
		S (100)	SX (100)	Patching
Air Voids, percent at: N (initial) [for information only] N (design)	CPL 5115	 3.5 – 4.5	 3.5 – 4.5	 3.5 – 4.5
Lab Compaction (Revolutions): N (initial) [for information only] N (design)	CPL 5115	 8 100	 8 100	 8 100
Stability, minimum	CPL 5106	30	30	30
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 Susceptibility 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 76-28	PG 76-28
Grade of Asphalt Cement, Layers below Top		PG 64-22		PG 64-22
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	65-75	65-75
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

Notes:
- AI MS-2 = Asphalt Institute Manual Series 2.
- The current version of CPL 5115 is available from the Department.
- Mixes with gradations having less than 40% passing the 4.75 mm (No. 4) sieve shall be approached with caution because of constructability problems.
- 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.

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REVISION OF SECTION 403
HOT MIX ASPHALT

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% below the Mix Design optimum.

For CDOT Roadways, the Department will establish the production asphalt cement and volumetric targets based on the Developer's mix design and the relationships shown between the hot mix asphalt mixture volumetric properties and asphalt cement contents on the Form 429. The Department may select a different AC content other than the one shown at optimum on the Developer's mix design in order to establish the production targets as contained on the Form 43. Historically, Air Voids adjustments typically result in asphalt cement increases from 0.1 to 0.5 percent.

Table 403-2

	Minimum Voids in the Mineral Aggregate (VMA)			
Nominal Maximum Size*, mm (inches)		*****Design Air Voids ****		
	3.5%	**4.0%**	**4.5%**	**5.0%**
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	N/A
12.5 (½)	14.6	14.7	14.8	
9.5 (⅜)	15.6	15.7	15.8	
4.75 (No. 4)	16.6	16.7	16.8	16.9

* 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.

As a part of the Developer's Quality Management Plan, the Developer shall outline the steps taken to minimize segregation of HMA. The Quality Management Plan shall define a process by which the Developer shall address unacceptable segregation, but, at a minimum, the paving shall stop and the cause of segregation shall be corrected before paving operations will be allowed to resume.

Department approved Warm Mix Asphalt (WMA) will be allowed on this project in accordance with CP 59 for I70 mainline.

Department approved Warm Mix Asphalt (WMA) may be allowed on this project for all other roadways in accordance with CP 59. Unique requirements for WMA design, production and acceptance testing as documented during Department 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 Developer's control and will be non-excusable HMA for patching

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REVISION OF SECTION 403
HOT MIX ASPHALT

shall conform to the requirements of the lift being patched. All patching determinations shall be the responsibility of the Developer with consultation with the Department.

A minimum of 1% hydrated lime by weight of the combined aggregate shall be added to the aggregate for all HMA.

Subsection 403.03 shall include the following:

The Developer shall use an approved anti-stripping additive. The amount of additive used shall be a minimum of 0.5 percent by weight of the asphalt cement. The additive shall be added at the refinery or at the hot plant. If liquid anti-stripping additive is added at the plant, an approved in-line blender must be used. The blender shall be in the line from the storage tank to the drier drum or pugmill. The blender shall apply sufficient mixing action to thoroughly mix the asphalt cement and anti- stripping additive.

The Developer shall perform the Construction Work such that all roadway pavement placed prior to the time paving operations end for the year shall be completed to the full thickness required by the plans.

REVISION OF SECTION 401 AND 703
STONE MATRIX ASPHALT PAVEMENT

Sections 401 and 703 of the Standard Specifications are hereby revised for this Project as follows:

Subsection 401.02 shall include the following:

Recycled Asphalt Pavement (RAP) shall not be used in Stone Matrix Asphalt (SMA) mix.

Subsection 401.09 shall include the following:

Each SMA load shall be completely covered and securely fastened with a full tarp.

Subsection 401.16 shall include the following:

The SMA mixture shall be transported and placed on the roadway without drain-down or flushing. All flushed areas behind the paver shall be removed immediately upon discovery. If more than 50 square feet of flushed SMA pavement is ordered removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the flushing has been found and corrected. The Department shall designate the depth and area of all flushed areas requiring removal and replacement. All costs associated with the removal and replacement of the flushed areas shall be at the Developer's expense.

Subsection 401.17 shall include the following:

Rollers shall not be used in a vibratory mode on SMA unless they are first used successfully in the demonstration control strip specified in subsection 403.03. Pneumatic wheel rollers shall not be used on SMA mix.

SMA pavement shall be placed and compacted in accordance with the temperatures listed in subsection 401.07 as revised for this Project.

The relative compaction for all SMA mixtures will be measured from roadway cores in accordance with CP 44, Method B, unless the SMA mixture is being placed on a structure (bridge deck) in which case the Department may specify that nuclear gauge measurements be used.

When cores are used, the Developer shall provide all labor and equipment for the coring operation and filling the core holes. When nuclear density gauges are used, the tests will be performed in accordance with CP 81 and CP 82.

In-place density for SMA shall be 93 to 97% of the SMA mix maximum specific gravity as measured according to CP 51.

Subsection 401.22 shall include the following:

Acceptance, testing, and pay factors for SMA shall be in accordance with subsections 105.05 and 106.05 as revised for this Project for HMA. The specifications for gradation acceptance shall be applied for all SMA placed on the project.

Subsection 703.06 shall include the following:

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REVISION OF SECTION 401 AND 703
STONE MATRIX ASPHALT PAVEMENT

Mineral filler for the SMA pavement shall be limestone dust and shall meet the requirements of this subsection and the following:

Plasticity Index (AASHTO T90) 4% Maximum

The Developer shall submit hydrometer analysis (AASHTO T88) for the mineral filler used in the SMA mix.

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

Subsection 403.01 shall include the following:

This work includes placing a Stone Matrix Asphalt (SMA) pavement as shown on the plans.

Subsection 403.02 shall include the following:

The SMA gradation for this project shall be ½ inch

Mixture design and field control testing of SMA shall be performed using either the SuperPave (CPL 5115, 100 Gyrations) or the Marshall Method (AASHTO T245, 50 Blow).

A minimum of two weeks prior to the proposed use of any Stone Matrix Asphalt pavement on the project, a pre-paving conference will be conducted. At that time, the Developer shall submit to the Department, a mix design meeting the appropriate specification requirements for one of the following:

The SuperPave SMA mix design shall conform to the requirements of Table 403-1a:

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REVISION OF SECTION 401 AND 703
STONE MATRIX ASPHALT PAVEMENT

Table 403-1a

Property	Test Method	Value for SMA
Air Voids, percent at: N(Design)	CPL 5115	3.0 – 4.0
Lab compaction (Revolutions) N(Design)	CPL 5115	100
Accelerated Moisture Susceptibility, tensile strength Ratio, (Lottman), minimum	CPL 5109, Method B	70
Minimum Dry Split Tensile Strength, psi	CPL 5109, Method B	30
Grade of Asphalt Cement		PG 76-28
Voids in the Mineral Aggregate (VMA) %,	CP 48	17

minimum		
Draindown at Production Temperature	AASHTO T305	0.3 maximum
% VCA^{1}_{MIX}	AASHTO R 46	Less than VCA_{DRC}[2]
Note: The current version of CPL 5115 is available from the Region Materials Engineer Note: Copies of AASHTO R 46 and M 325 can be obtained from the Region Materials Engineer Note: [1]Voids in the Coarse Aggregate Note: [2]Dry-rodded condition		

For CDOT Roadways the 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. The Department will establish the production asphalt cement and volumetric targets based on the Developer's mix design and the relationships shown between the Stone Matrix Asphalt mixture volumetric properties and asphalt cement contents on the Form 429. The Department may select a different AC content other than the one shown at optimum on the Developer's mix design in order to establish the production targets as contained on the Form 43. Historically, Air Voids adjustments typically result in asphalt cement increases from 0.1 to 0.5 percent. Developers bidding the project should anticipate this change and factor it into their unit price bid.

The Marshall SMA mix design shall conform to the following:

Mix Properties	Value
Stability, Marshall Compactor	1400 lbs., min
% Voids in Total Mix	3 – 4%
VMA (% Voids in the Mineral Aggregate)	17 min.
Lottman, CPL 5109, Method B	70% min
Dry Tensile Strength, (CPL 5109)	30 psi, min.

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REVISION OF SECTION 401 AND 703
STONE MATRIX ASPHALT PAVEMENT

Regardless of mix design method, a minimum of 1 percent hydrated lime by weight of the combined aggregate shall be added to the aggregate for all Stone Matrix Asphalt.

For CDOT Roadways, the SMA Mix design must be Accepted by the Department before any pavement is placed on the project. In addition, the Developer shall provide field control testing during production of the SMA mix and for the demonstration control strip. The Developer shall perform the following tests and provide the results to the Department during production:

If a SuperPave SMA mix design is used, the Developer shall perform the following tests and provide the results to the Department during production:

Superpave Mix Property	Frequency
Draindown (AASHTO T 305)	1/1000 tons or fraction thereof
Percent Voids in the total mix @ $N_{(design)}$	1/1000 tons or fraction thereof
VMA (Percent Voids in the Mineral Aggregate) @ $N_{(design)}$	1/1000 tons or fraction thereof

Lottman, CPL 5109, Method B	1/5000 tons or fraction thereof
Dry Tensile Strength, CPL 5109	1/5000 tons or fraction thereof
Percent AC & Aggregate Gradation CP 5120	1/1000 tons or fraction thereof

If a Marshall SMA mix design is used, the Developer shall perform the following tests and provide the results to the Department during production:

Marshall Mix Property	Frequency
Draindown (AASHTO T 305)	1/1000 tons or fraction thereof
Stability (Marshall)	1/1000 tons or fraction thereof
Percent Voids in the total mix	1/1000 tons or fraction thereof
VMA (Percent Voids in the Mineral Aggregate)	1/1000 tons or fraction thereof
Lottman, CPL 5109, Method B	1/5000 tons or fraction thereof
Dry Tensile Strength, CPL 5109	1/5000 tons or fraction thereof
Percent AC & Aggregate Gradation CP 5120	1/1000 tons or fraction thereof

Subsection 403.03 shall include the following:

The mineral filler for SMA shall be stored in a separate silo and added automatically in the correct proportion. The mineral filler addition equipment shall be electronically or mechanically interlocked to the aggregate feed sensors so that the proper amount of mineral filler is added whenever SMA is produced.

The SMA mineral filler shall be added at the same point the asphalt cement is added to the aggregate.

Tack coat between the existing pavement and Stone Matrix Asphalt pavement shall be placed at a rate between 0.03 and 0.05 gallons per square yard.

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REVISION OF SECTION 401 AND 703
STONE MATRIX ASPHALT PAVEMENT

For CDOT Roadways, and before proceeding with SMA placement, the Developer shall demonstrate the ability to produce and place a satisfactory mix in a Demonstration Control Strip (DCS). The Developer will coordinate with the Department on the proposed location of the DCS. The DCS shall consist of a minimum quantity of 500 tons placed in one lane, full width. Within the last 200 tons of SMA placed in the DCS, the Developer and Department shall determine properties (VMA, Voids, in-place density, AC content, gradation, and Marshall Stability, if required) of the project produced SMA mix used in the DCS and provide the results to the Department. The Developer may proceed with full production if all mixture properties are within the specified tolerances.

To determine the in-place density and roller pattern, one core shall be taken at three random locations within the last 200 tons of the DCS. The Department will determine the coring locations using a stratified random sampling process. The cores shall be immediately submitted to the Department and will be used for determining acceptance of the DCS. Densities of the random samples will be determined by cores according to CP 44. Coring shall be performed by the Developer under Department observation. Coring will not be measured and paid for separately but shall be included in the work.

The DCS will be designated as a separate process.

REVISION OF SECTION 412
PORTLAND CEMENT CONCRETE PAVEMENT

Section 412 of the Standard Specifications is hereby revised for this project as follows:

Subsection 412.13(b) 1 shall include the following:

> If tie bars are inserted into plastic concrete with a tie bar insertion machine, tie bar location and concrete consolidation shall be subject to the following additional requirements:
>
> Each 2500 linear feet of longitudinal weakened plane joint resulting from the procedure shall have one random location cored where the core intercepts an inserted tie bar. The core shall be six-inch diameter taken in the presence of the Engineer.
>
> If non-consolidated concrete is evident above the inserted tie bar, the Developer shall cease paving operations and submit a corrective action plan in writing for approval. Correction of the joint and further paving shall take place only after written approval of the corrective action plan has been provided by the Engineer. Additional coring may be required, as directed by the Department. Coring operations, including patching, shall be at the Developer's expense.
>
> Further failure to consolidate the concrete over the tie-bars will be justification to preclude the use of automatic tie-bar insertion for the remainder of the project.

REVISION OF SECTION 621
DETOURS

Section 621 is hereby added to the Standard Specifications for this Project and shall include:

This work consists of designing and constructing detours for all phases of construction on I-70 Mainline and all applicable side streets; maintenance of the detours; removal of the detours; and removal and replacement of appurtenances required to construct and operate the detours including but not limited to guardrail, curb and gutter, detour pavement, embankment material and unclassified excavations.

The Developer shall provide a paved surface for all detours. The Developer shall determine the type and thickness of pavement that shall be used to accommodate the traffic loadings. All materials required for detour shall comply with project standard specifications and special provisions.

The Developer shall maintain the detour pavement for the entire period that it is open to the traveling public, including all temporary approaches, accesses, crossings, and intersections with adjacent roads and streets. Detour pavements shall be maintained in good operating condition devoid of potholes, uneven surfaces, and rutting. The Department may direct the Developer to repair or replace detour pavements if, in the Department's sole discretion, detour pavements are determined to be in poor condition.

The Developer shall be responsible for quality control required to assure adequate quality of embankment material, aggregate base course, HMA used in the construction of the detour.

The detour locations and dimensions for all phases of construction shall be as shown on the Developer's plans.

If the materials and thickness furnished for the detour pavement result in an inadequate detour structure, the Developer will provide additional thickness, materials, or other measures necessary to provide a satisfactory pavement for the life of the detour. These additional improvements shall be furnished at no additional cost. All necessary signs, pavement markings and other traffic control devices shall be provided in accordance with the Developer's Traffic Control Plan.

The finished transverse and longitudinal surface elevation of any detour or patch shall be measured using a 10 foot straightedge. Areas to be measured will be directed by the Department. The Developer shall furnish an approved 10 foot straightedge, depth gauge and operator to aid the Department in testing the pavement surface. Areas showing high spots of more than 3/16 inch in 10 feet shall be marked and diamond ground until the high spot does not exceed 3/16 inch in 10 feet.

The Developer shall maintain the detour for the entire period that it is open to traffic. Any distress, in the Department's opinion, that affects the ride, safety, or serviceability of the detour roadway shall be corrected to the satisfaction of the Department at the expense of the Developer.

The Developer shall be responsible for the complete removal and disposal of all temporary detour pavement prior to Substantial Completion.

7. EARTHWORK

7.1 Applicable Standards

All Construction Work required to be performed by the Developer pursuant to this Section shall comply with Schedule 10A Applicable Standards and Specifications, the relevant requirements listed in this Section, and Good Industry Practice.

7.2 Clearing and Grubbing

7.2.1 The Developer shall be responsible for all clearing and grubbing and earthwork requirements for the Construction Work.

7.2.2 The Developer shall be responsible for clearing and grubbing including, without limitation, the removal of trees, logs, stumps, brush, trash, etc. from the Site prior to the start of any Construction Work and shall comply with any additional requirements for the affected area in accordance with Schedule 17 Environmental Requirements.

7.2.3 The Developer shall conduct a pre-clear and grub meeting with the Department prior to the start of any Construction Work to agree to the limits of clearing and grubbing, removal, replacement, or transplanting of any trees and shrubs.

7.2.4 The Developer shall include clearing and grubbing limits as part of each design submittal for all Construction Work in that area. Such submittals shall include provisions for the removal, replacement or transplanting of any trees.

7.3 Material Requirements

7.3.1 All Construction Work shall be conducted in accordance with the CDOT *Pavement Design Manual* and the CDOT *Field Materials Manual*.

7.3.2 Unless otherwise specified in this Section, the Developer may use on-Site materials for subgrade on the Project provided that it can be demonstrated by tests that they comply with the material property requirements included in Section 203 of the CDOT *Standard Specifications*. Such test data shall be submitted to the Department for Information prior to use of the material on the Project.

7.3.3 The R-Value of materials acquired from on-Site excavations and subsequently used in embankments on the Project shall have a minimum R-Value of 20 when placed within the Ultimate configuration roadway prism. All compaction shall be in accordance with Section 203 of the CDOT *Standard Specifications*.

7.3.4 Preliminary subsurface investigations are included in the Reference Documents. The Developer shall conduct a supplemental soil survey to confirm/ascertain whether the existing roadway soil satisfies the material requirements of this Section if it is desired to re-use this soil in the roadway prism. If the existing roadway soils are re-used, the material will be tested as stated in the CDOT *Field Materials Manual* during construction. This supplemental soil survey shall conform to the requirements as stated in the 2016 CDOT *Field Materials Manual*. Test holes are required at a minimum of 1,000 feet. The Developer shall provide any additional mitigation required as a result of the supplemental soil survey.

7.3.5 The results of any supplemental soil surveys conducted by the Developer together with any proposed mitigation measures to address matters identified in the surveys shall be submitted to the Department for Information before any pavement and pavement-related work commences. Such information shall be submitted in a report format that clearly and concisely describes the existing soil conditions, delineates areas needing mitigation, and defines the mitigation measures. The report shall include a soil profile, boring log, and the test results.

7.3.6 Alternative subgrade treatment proposals shall be submitted to the Department for Acceptance prior to incorporation into the Construction Work. Locations where any alternative subgrade treatments are utilized on the Project shall be shown on the As-Built documents.

7.3.7 The Developer shall be responsible for identifying sources of material required for the Project.

7.3.8 The Developer shall be responsible for disposing of all surplus material off-Site. Refer to Section 4.D of the Denver IGA for additional requirements for the disposing of surplus material.

7.4 CDOT Roadways

7.4.1 The subgrade on the CDOT Roadways shall consist of a minimum of six inches of Aggregate Base Course (ABC) Class 6 and be underlain by at least 24 inches of material with an R-value greater than or equal to 20. Soil in the zone one foot beneath the R-20 material shall be treated in accordance with Section 203 of the CDOT *Standards Specifications*.

7.4.2 Subgrade on CDOT Roadways shall have a percent swell less than or equal to one to a depth of three feet below the bottom of the proposed ABC Class 6 as determined by ASTM D-4546. A percent swell less than or equal to one corresponds to a low probable swell damage risk. Swell tests are required to verify the percent swell of the existing soil is less than or equal to one percent. If the swell index is greater than one percent, mitigation is required to a minimum depth of three feet below the base of the proposed ABC Class 6. The Developer shall demonstrate that any proposed mitigation measures will result in one percent swell less than or equal to one percent when tested with a 200 psf surcharge pursuant to ASTM D-4546.

7.5 Local Agency Roadways

The subgrade on Local Agency Roadways shall meet the minimum resistance values (R-value, k-value, classification) as specified by the Local Agency.

7.6 Compaction Requirements

Depth of moisture-density control shall be as follows:

a. Full depth of all embankments;

b. Six inches for bases of cuts and fills; and

c. 12 inches underneath the proposed pavement section (pavement/base course).

7.7 Reuse of Materials

7.7.1 Broken, crushed or milled asphalt substituted for ABC Class 6 shall meet the grading requirements of ABC Class 6 Special. The ABC Class 6 Special may be substituted for ABC Class 6 except under hot mix asphalt.

7.7.2 The existing subgrade will be allowed to remain in-place if it meets the requirements listed previously.

7.7.3 The Developer shall not excavate or remove any material from within the roadway, which is not within the grading limits, as indicated by the slope and grade lines.

7.8 Geotextiles

7.8.1 The Developer shall include as part of its pavement design submittals the locations where geotextile installation is proposed. The geotextile shall be installed in accordance with manufacturer's recommendations.

7.8.2 Geotextiles shall meet the requirements for Geotextile Class I (per American Association of State and Highway Officials (AASHTO) M 288) and be approved for stabilization and separation applications.

7.9 Deliverables

7.9.1 At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the specified timeframes:

Table 7-1 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Results of supplemental soil survey along with any proposed mitigation measures	Information	Before any embankment, aggregate base course, pavement and pavement-related Construction Work commences
Alternative subgrade treatments	Acceptance	Before any embankment, aggregate base course, pavement and pavement-related Construction Work commences
Locations requiring geotextile installation	Information	Submitted with pavement mix designs

8. DRAINAGE

8.1 General

8.1.1 The Developer shall be responsible for the design, installation and construction of all drainage systems and outfalls required for the Construction Work. The Construction Work shall comply with the CDOT Municipal Separate Storm Sewer System (MS4) Permit.

8.1.2 The Developer shall obtain necessary Temporary Easements, Permits and Additional ROW Parcels prior to the Construction Work and shall not adversely impact property owners outside the Project.

8.1.3 The Developer shall:

a. Design, install, and construct a complete storm drainage system to intercept and remove surface runoff from the I-70 Mainline, CDOT Roadways and Local Agency Roadways;

b. Maintain surface, channel, and conduit flow through the Right-of-Way and Additional Right-of-Way; and

c. Be responsible for drainage-related hazards within and outside the Site, public inconvenience, flood damages, and water quality impacts during construction.

8.1.4 For reference only and subject always to Section 3 of the Project Agreement, the Draft Master Plan Drainage Report and Draft Master Plan Water Quality Report are provided as Reference Documents. The reports provide concepts for Offsite and Onsite drainage design, detention and general location for permanent water quality features.

8.2 Applicable Standards

All Construction Work required to be performed by the Developer pursuant to this Section shall comply with Schedule 10A Applicable Standards and Specifications, the relevant requirements listed in this Section, and Good Industry Practice.

8.2.1 Software

The Developer shall use the following software in performing drainage design calculations:

a. CUHP/EPA-SWMM;

b. USACE, HEC-RAS;

c. FHWA, HY-8;

d. InRoads Storm and Sanitary; and

e. FLO-2D.

8.3 Administrative Requirements

8.3.1 Local Agency Roadways

The Developer shall submit plans, reports and applicable Governmental Approvals directly to the Local Agencies as part of the deliverable process. Design, construction and installation shall conform to Local Agency requirements and standards.

8.3.2 Coordination with Other Agencies

a. The Department has coordinated with City and County of Denver (CCD) and Urban Drainage and Flood Control District (UDFCD) for design flows from the Montclair and Park Hill Basins. For reference only and subject always to Section 3 of the Project Agreement, these reports are provided as Reference Documents.

b. The Developer shall coordinate all drainage related issues with affected Governmental Authorities. The Developer shall include the Department in all correspondence with the appropriate Governmental Authorities.

c. The Developer shall coordinate all drainage related issues, as related to Construction Work on Railroad right-of-way, with the affected Railroad. The Developer shall obtain all required Permits, as described in Schedule 18 Right-of-Way and Section 8.4.

8.3.3 Permits

The Developer shall comply with the requirements of the environmental and stormwater Permits that are necessary for installation and operation of the Construction Work. The Developer is obligated to adhere to the following Permit requirements:

a. Colorado Discharge Permit System-Stormwater Construction Permit

The Developer shall be responsible for obtaining the Colorado Discharge Permit System-Stormwater Construction Permit (CDPS-SCP) and shall comply with all stormwater Permit requirements until final stabilization has been achieved and until the CDPS-SCP Permit can be closed. This includes the maintenance of all Best Management Practices (BMPs), maintenance of all seeded/landscaped areas, and removal of all Best Management Practices (BMPs) once all erosion potential has been eliminated.

b. Storm Water Management Plan

The Developer's Stormwater Management Plan (SWMP) is required to fulfill the requirements of the CDPS-SCP and shall follow the format of the CDOT SWMP template.

c. Best Management Practices

BMPs are required to fulfill the requirements of the SWMP. The Developer shall design, install and maintain construction BMPs for the Construction Work in accordance with the CDOT *Erosion Control and Stormwater Quality Guide*.

d. CDOT New Development Redevelopment Interim Program Guidance

The New Development Redevelopment Program, also referred to as the CDOT Permanent Water Quality (PWQ) Program, is required under CDOT's MS4 Permit. The Developer shall comply with the most current version of the New Development Redevelopment (NDRD) Interim Program Guidance at the time of the Setting Date.

i. The Developer shall install Permanent Stormwater Quality Facilities (PSQFs) in accordance with the CDOT *Erosion Control and Stormwater Quality Guide* and the UDFCD *Urban Storm Drainage Criteria Manual*;

ii. Storm runoff from the Project is tributary to the South Platte River which is classified as a 303d impaired steam. A figure is included in the Draft Master Plan Water Quality Report that describes each stream segment;

iii. Runoff from impervious areas outside ROW shall follow the Local Agency MS4 Permit for any required PSQFs.

e. US Army Corps of Engineers Permit

The Developer shall be responsible for portions of the storm drainage system that are subject to Permitting under Section 404 of the Clean Water Act. Refer to Schedule 17 Environmental Requirements for additional requirements.

f. Colorado Senate Bill 40 Permit

The Developer shall be responsible for portions of the storm drainage system that are subject to Permitting under Colorado Senate Bill (SB) 40. Refer to Schedule 17 Environmental Requirements for additional requirements.

g. Groundwater Permits

The Developer shall be responsible for Permit requirements associated with dewatering for both temporary during construction and post construction Activities. A Construction

Dewatering Permit is required for temporary dewatering Activities during the Construction Work. A Subterranean Groundwater Permit is required if groundwater is collected and conveyed to the ground surface via sub-surface or Storm Drains (point source). Following Substantial Completion, the Permit will be the responsibility of the Developer. Refer to Schedule 17 Environmental Requirements for additional requirements.

8.4 Design Requirements

8.4.1 Data Collection

a. The Developer shall identify all drainage-related issues utilizing available data and requirements imposed by Law concerning the Construction Work. Drainage related issues include, but are not limited to: areas with historically inadequate drainage (as evidenced by recorded flooding or citizen complaints), environmentally sensitive areas, and known drainage related maintenance problems;

b. The Developer is solely responsible for obtaining all relevant storm drainage improvement plans, drainage planning studies, and drainage reports for the Construction Work;

c. The Developer is solely responsible for obtaining existing and future land use information from all Local Agencies and shall design facilities to be compatible with drainage systems, existing or proposed, on adjacent properties;

d. For reference only and subject always to Section 3 of the Project Agreement, certain drainage structure surveys are provided the Reference Documents; and

e. The Developer shall perform such detailed mapping and surveys as it determines necessary to verify locations of existing drainage and Utility features necessary for the proposed drainage design. The Developer shall verify or identify boundaries, flow patterns, and land use of drainage basins based on field observations.

8.4.2 Ultimate Design

The Developer shall design and construct all drainage facilities to the Ultimate design from Brighton Boulevard to Sand Creek. The Developer shall design and construct all ponds for the Ultimate design from Sand Creek to Chambers Road. All other drainage facilities, between Sand Creek and Chambers Road, shall be designed and constructed to accommodate the Construction Work.

8.4.3 Surface Hydrology

The Developer shall perform hydrologic analyses for all Onsite and Offsite drainage basins that are adjacent to and contribute runoff to the Project. The analysis shall be based on future land use information and the Ultimate design. The hydrologic analyses shall identify impacts to the existing drainage systems outside the Project area.

a. Design Frequencies

For the I-70 Mainline and CDOT Roadways, the design frequency for the minor and major storm shall be the 10 and 100 year event, respectively.

b. Precipitation

The Developer shall design all drainage elements using the precipitation data given in Tables 8-1, 8-2 and 8-3 provided that such data establishes the minimum design criteria for such elements and the use thereof does not relieve the Developer of any risks, responsibilities or liabilities that it otherwise assumes pursuant to the Project Agreement (including in relation to the risk of flooding).

Table 8-1 Intensity-Duration Frequency Data (in/hr)

Frequency	5 min	10 min	15 min	30 min	60 min
2 year	3.22	2.57	2.16	1.49	0.95
5 year	4.55	3.63	3.04	2.10	1.34
10 year	5.26	4.19	3.52	2.43	1.55
50 year	7.63	6.09	5.11	3.53	2.25
100 year	8.72	6.95	5.83	4.03	2.57

Table 8-2 Incremental Rainfall Depth/Return Period (in)

Time (min)	Basins less than 5 sq. miles					Basins between 5 and 10 sq. miles					Basins between 10 and 20 sq. miles				
	2 yr	5 yr	10 yr	50 yr	100 yr	2 yr	5 yr	10 yr	50 yr	100 yr	2 yr	5 yr	10 yr	50 yr	100 yr
5	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
10	0.04	0.05	0.06	0.08	0.08	0.04	0.05	0.06	0.08	0.08	0.04	0.05	0.06	0.08	0.08
15	0.08	0.12	0.13	0.11	0.12	0.08	0.11	0.12	0.11	0.12	0.08	0.12	0.13	0.11	0.12
20	0.15	0.21	0.23	0.18	0.21	0.13	0.18	0.20	0.18	0.21	0.15	0.21	0.23	0.18	0.21
25	0.24	0.34	0.39	0.34	0.36	0.20	0.29	0.33	0.34	0.36	0.23	0.34	0.39	0.34	0.36
30	0.13	0.17	0.19	0.56	0.64	0.11	0.15	0.16	0.56	0.64	0.13	0.17	0.19	0.56	0.64
35	0.06	0.08	0.09	0.27	0.36	0.06	0.08	0.08	0.27	0.36	0.06	0.08	0.09	0.27	0.36
40	0.05	0.06	0.07	0.18	0.21	0.05	0.06	0.06	0.18	0.21	0.05	0.06	0.07	0.18	0.21
45	0.03	0.05	0.06	0.11	0.16	0.03	0.05	0.06	0.11	0.16	0.03	0.05	0.06	0.11	0.16
50	0.03	0.05	0.05	0.11	0.13	0.03	0.05	0.05	0.11	0.13	0.03	0.05	0.05	0.11	0.13
55	0.03	0.04	0.05	0.07	0.10	0.03	0.04	0.05	0.07	0.10	0.03	0.04	0.05	0.07	0.10
60	0.03	0.04	0.05	0.07	0.10	0.03	0.04	0.05	0.07	0.10	0.03	0.04	0.05	0.07	0.10
65	0.03	0.04	0.05	0.07	0.10	0.03	0.04	0.05	0.07	0.10	0.03	0.04	0.05	0.07	0.10
70	0.02	0.04	0.05	0.05	0.05	0.02	0.04	0.05	0.05	0.05	0.02	0.04	0.05	0.05	0.05
75	0.02	0.03	0.05	0.05	0.05	0.02	0.03	0.05	0.05	0.05	0.02	0.03	0.05	0.05	0.05
80	0.02	0.03	0.04	0.04	0.03	0.02	0.03	0.04	0.04	0.03	0.02	0.03	0.04	0.04	0.03
85	0.02	0.03	0.03	0.04	0.03	0.02	0.03	0.03	0.04	0.03	0.02	0.03	0.03	0.04	0.03
90	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
95	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
100	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
105	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
110	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
115	0.01	0.02	0.03	0.03	0.03	0.01	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
120	0.01	0.02	0.02	0.03	0.03	0.01	0.02	0.02	0.03	0.03	0.01	0.02	0.02	0.03	0.03
125											0.01	0.01	0.02	0.02	0.01
130											0.01	0.01	0.02	0.02	0.01
135											0.01	0.01	0.02	0.02	0.01
140											0.01	0.01	0.02	0.02	0.01
145											0.01	0.01	0.02	0.02	0.01
150											0.01	0.01	0.02	0.02	0.01

Time (min)	Basins less than 5 sq. miles					Basins between 5 and 10 sq. miles					Basins between 10 and 20 sq. miles				
	2 yr	5 yr	10 yr	50 yr	100 yr	2 yr	5 yr	10 yr	50 yr	100 yr	2 yr	5 yr	10 yr	50 yr	100 yr
155											0.01	0.01	0.02	0.02	0.01
160											0.01	0.01	0.02	0.02	0.01
165											0.01	0.01	0.02	0.02	0.01
170											0.01	0.01	0.02	0.02	0.01
175											0.01	0.01	0.02	0.02	0.01
180											0.01	0.01	0.02	0.02	0.01
	1.10	1.55	1.79	2.60	2.97	1.02	1.44	1.67	2.60	2.97	1.25	1.72	2.01	2.78	3.14

Table 8-3 One-Hour Point Rainfall (in)

2 Year	5 Year	10 Year	50 Year	100 Year
0.95	1.34	1.55	2.25	2.57

c. Hydrologic Methods

i. The Developer shall perform the necessary hydrologic analyses using the following methods:

A. Areas less than 90 acres shall be evaluated using the rational method. The minimum time of concentration shall be 5 minutes;

B. Areas between 90 and 160 acres shall be analyzed using the Colorado Urban Hydrograph Procedure/Environmental Protection Agency Storm Water Management Model (CUHP/EPA-SWMM) procedure for peak flow only;

C. Areas greater than 160 acres shall be evaluated using the CUHP/EPA-SWMM procedure; and

D. The area draining to the Lowered Section of the I-70 Mainline shall use the CUHP/EPA-SWMM procedure for peak flow only.

ii. The hydrologic analyses shall be based on fully developed conditions and the Ultimate design.

8.4.4 Hydraulic Structures

a. Roadways

i. Roadway component geometric configurations shall be designed to provide positive drainage to prevent hydroplaning and roadway icing. Cross slopes shall be designed and constructed in accordance with the requirements of Schedule 10, Section 9 Roadway.

A. Roadway Profile

Longitudinal grades shall be designed and constructed in accordance with the requirements of Schedule 10, Section 9 Roadway.

B. Allowable Flow Spreads

The Developer shall design all required Storm Drain systems to meet the allowable spread criteria given in Table 8-4.

Table 8-4 Roadway Storm Drain Design Frequency and Allowable Spread Criteria

Road Classification		Design Frequency	Allowable Spread into Travel Lane
I-70 Mainline		10 year	0 feet
		100 year	4 feet
I-70 Mainline Entrance/Exit Ramps and CDOT Roadways	< or = 45 mph	10 year	3 feet
	< or = 45 mph	100 year	Half of adjacent travel lane
	> 45 mph	10 year	0 feet
	> 45 mph	100 year	4 feet
Local Agency Roadway		Local Agency Criteria	

C. Edge Treatment

In areas where the roadway pavement discharges runoff to Type 7 Guardrail, Type 3 Guardrail with curb, or at the end of curb returns, flows shall be collected and piped to the toe of the embankment slope. CDOT standard Type 3 Embankment Protectors or inlets shall be used at these locations. Erosion protection shall be constructed at all outfalls.

D. Roadside Ditches and Open Channels

(I) For roadside ditches along all existing and proposed roadways, the water surface profile shall have a minimum of one foot of freeboard for the 10 year return frequency peak discharge and shall not exceed edge of pavement for the 100 year return frequency peak discharge;

(II) All open channels within the Project shall be designed to capture and convey the 100 year return frequency with a minimum one foot of freeboard. Capacity shall be determined using manning's equation;

(III) All ditches and open channels with a grade exceeding two percent shall be constructed with a turf reinforcement mat or other means. Concrete or asphalt lining shall be considered in areas determined by the Developer as difficult to maintain regardless of slope or capacity; and

(IV) Flexible channel linings shall be designed in accordance with Federal Highway Administration (FHWA) *HEC-15, Design of Roadside Channels with Flexible Linings*. Riprap channel lining shall be designed in accordance with FHWA *HEC-11, Design of Riprap Revetment*.

ii. Removals

Existing Cross Drains, Storm Drains, embankment protectors and drainage appurtenances within the Project shall be removed and replaced in their entirety. The Developer shall:

A. Maintain historic flow patterns; and

B. Design and construct for the Ultimate design, as described in the Section.

iii. Cross Drains

A. Cross Drains are pipes or culverts that convey water from one side of the road to the otherwithout interruption. Pipes connected to manholes or inlets placed in line with a Cross Drain will be referred to as a Storm Drain for the purposes of the Project Agreement;

B. Horizontal and vertical alignment of Cross Drains shall be straight with no grade breaks or bends;

C. The use of sag pipes or inverted siphons shall not be allowed to convey stormwater;

D. All Cross Drains shall be designed for the 100 year return frequency peak discharge with no overtopping of the I-70 Mainline. The Developer shall refer to this Section in regards to Ultimate design. Hydraulic design of Cross Drains shall be based on the procedures included in FHWA *HDS No. 5, Hydraulic Design of Highway Culverts*;

E. The minimum allowable pipe size for Cross Drains shall be 36 inches. End sections, or headwalls with beveled edges and wingwalls, shall be provided for all Cross Drains regardless of size. To reduce sizes improved inlets may be utilized. Improved inlets shall be designed based on FHWA *HEC-13, Hydraulic Design of Improved Inlets for Culverts*;

F. Allowable headwater elevation for the 100 year return frequency peak discharge shall be designed as described in the CDOT *Drainage Design Manual*; and

G. In some locations, the existing Cross Drains may be via porous, open-graded, free draining fill, rather than Cross Drains. The Developer shall provide Cross Drains in these locations.

iv. Storm Drains

A. Storm Drains shall be defined as a network of pipes that connects inlets, manholes, and other drainage features to an outfall. Cross Drains connected to a Storm Drain system are considered Storm Drains for the purposes of the Project Agreement;

B. Horizontal and vertical alignment of Storm Drains shall be straight with no grade breaks or bends;

C. The Storm Drain system shall be designed to not worsen the existing conditions for properties outside the ROW. Ponding will not be permitted within the Site except at specifically designed stormwater detention and/or water quality facilities; and

D. At locations where 100 year detention is to be provided, the Storm Drain system shall capture and convey the 100 year flows to the detention pond. Hydraulic analyses and plans for Storm Drains that are connected to existing systems upstream or downstream of the Project shall be coordinated with affected Local Agencies. The hydraulic analyses shall identify impacts to the existing Storm Drain systems caused by the connections and proposed combined peak-design discharges for the overall systems.

v. The minimum allowable diameter for any pipe in a Storm Drain system shall be 18 inches. The Developer shall not decrease Storm Drain size in the downstream direction.

A. Hydraulic Design of Storm Drains

(I) Storm Drain design shall be performed using hydraulic gradient analysis to account for all friction and minor losses. Friction losses shall be calculated using manning's equation. Minor losses at junctions, manholes, bends, and other appurtenances shall be calculated based on design procedures in the FHWA *HEC-22, Urban Drainage Design Manual*;

(II) Storm Drains under the I-70 Mainline shall be designed under free flow conditions for the 10 year return frequency peak discharge for Ultimate design. The hydraulic gradient for the 100 year return frequency shall be

below top of pavement, inlet, grate, or manhole lid for the Ultimate design; and

(III) The velocity of flow for Storm Drains shall not be less than three feet per second for the minor storm discharge (10 year) return frequency peak discharge and shall not be greater than 22 feet per second for the major storm discharge (100 year).

B. Inlets

(I) Inlets are required at locations to collect runoff within the design controls specified in this section. In addition, there are a number of locations where inlets may be necessary with little regard to contributing drainage area. These locations shall be designated on the plans prior to computations regarding discharge, water spread, inlet capacity, or bypass. Examples of such locations can be found in Chapter 13.4.2 of the CDOT *Drainage Design Manual*;

(II) CDOT *M & S Standard Plans* inlets shall be used on all CDOT Roadways. Inlets and their grates shall be designed for HS-20 or interstate alternate live loading;

(III) The following criteria apply to inlets

(aa) Type C and Type D inlets shall not be allowed within the roadway pavement limits unless used in conjunction with embankment protectors;

(bb) Vane grate inlets shall be used in the shoulders of I-70 Mainline;

(cc) Close mesh grates shall be used for Type C and D inlets near pedestrian areas;

(dd) Concrete aprons shall be installed on Type C and D inlets; and

(ee) Type 13 or Type C inlets shall be used in conjunction with valley pans.

(IV) Inlet hydraulic efficiency and spacing shall be determined based on design procedures in the FHWA *HEC-22, Urban Drainage Design Manual*. One hundred percent of the bypass flow shall be added to the next downstream inlet;

(V) For a continuous Storm Drain system, maximum inlet spacing shall be designed based on allowable flow spread or the manhole spacing criteria, whichever is less;

(VI) The sag vertical curve or sump area on a roadway requires an inlet at the lowest point and flanking inlets on each side of the lowest inlet to provide relief from debris clogging. Inlets shall be located such that the design criteria for spread are maintained;

(VII) Inlets are required 10 feet upstream from the point where the street cross slope begins to super-elevate toward the opposite side to minimize cross street flow. Bypass flow across the I-70 Mainline shall be limited to 0.1 cfs or less. Sump inlets shall not be placed at the zero point of the superelevation transition;

(VIII) Trench drains will not be allowed in the traveled way or transverse to traffic flow on the I-70 Mainline;

(IX) Valley gutters across connecting streets shall not be allowed. Drainage runoff shall be intercepted upstream from connecting streets for subsurface conveyance;

(X) Inlets and inlet aprons shall not be located in the travel lanes of the I-70 Mainline or CDOT Roadways; and

(XI) A clogging factor of 50 percent shall be used for sizing single-unit inlet grates. A clogging factor of 10 percent shall be used for sizing single-unit curb opening inlets. For multiple-unit inlets, the clogging factor may be reduced as recommended in the UDFCD *Urban Storm Drainage Criteria Manual, Volume I*, Chapter 6, Section 3.

C. Manholes and Junction Structures

(I) Manholes shall be incorporated into the Storm Drain system to provide access for inspection, cleaning, and other maintenance activities. Manholes shall be constructed at all junctions, changes in pipe size, drops, and grade changes. Manholes shall be provided at any change in horizontal alignment greater than two degrees. Manholes shall not be located in the wheel path of CDOT Roadways or travel lanes of the I-70 Mainline;

(II) A lateral that is less than half inside diameter of the trunkline and no more than 75 feet long may be connected to the trunkline with a prefabricated pipe wye, tee connection, or by penetration in conjunction with a concrete collar. Larger laterals shall be connected to the trunkline with a manhole;

(III) The spacing of manholes shall be in accordance with the criteria identified in the CDOT *Drainage Design Manual*;

(IV) Manhole and junction structure floors shall be shaped to fit the pipe inverts; and

(V) Pipe connections to manholes with material other than concrete shall be submitted to the Department for Information.

b. Drain Outfalls

i. Cross Drain and Storm Drain outfalls shall be designed such that the outlet elevation matches the receiving drainageway flowline. Outfalls shall be oriented in a downstream direction and designed to minimize existing habitat disturbances during construction;

ii. Permanent erosion protection shall be provided at all outfalls and along the drainage flowlines where needed. Energy dissipaters shall be designed in accordance with the FHWA *HEC-14 Hydraulic Design of Energy Dissipaters for Culverts and Channels*, or UDFCD *Design of Low Tailwater Riprap Basins for Storm Sewer Pipe Outlets;*

iii. All drain outfalls require either a headwall or end section. End sections or headwalls shall be used for drains 48 inches and smaller. A headwall shall be used for any drain 54 inches and larger. A concrete apron shall be required when wingwalls are utilized with a headwall. Saddle headwalls shall not be used. Concrete pipe joint fasteners for end sections shall be installed so that a minimum of 15 linear feet of the outlet end of the pipe are mechanically locked together; and

iv. The effect of tailwater in the receiving drainageway on the hydraulics of the outfall shall be evaluated. The design frequency of the tailwater of the receiving drainageway shall be based on the comparison of design discharge frequencies for

coincidental occurrence included in the FHWA *HEC-22, Urban Drainage Design Manual*.

c. Scour and Erosion Control

i. All existing scour, rill or channel erosion issues within the Construction Work shall be repaired by the Developer;

ii. The Developer shall analyze all bridges and open-bottom Cross Drains for scour, and design appropriate protection/mitigation per HEC-18, *Evaluating Scour at Bridges* and HEC-23*, Bridge Scour and Stream Instability Countermeasures Experience, Selection, and Design Guidance, Volume 1 and 2;*

iii. The Developer shall analyze all channel changes, realignments and crossings for erosion and scour potential and design and construct appropriate protection or mitigation per *HEC-20, Stream Stability at Highway Structures*;

iv. The following criteria apply to riprap layer thickness:

A. Thickness shall not be less than the spherical diameter of the D100 stone or less than two times the spherical diameter of the D50 stone, whichever results in the greater thickness;

B. Thickness shall not be less than 12 inches for practical placement;

C. The thickness determined by either criteria A or B shall be increased by 50 percent where the riprap is placed underwater; and

D. Oversized stones shall not be used.

v. Geotextile (Erosion Control Class 1) shall be used under all riprap per CDOT *M & S Standard Plans*.

d. Temporary Construction Drainage

i. The Developer shall submit Temporary Drainage Plans, to the Department for Acceptance. The location of existing drains shall be determined by the Developer and submitted to the Department as included in the Temporary Drainage Plans. Abandonment of temporary construction drainage items shall be included with Temporary Drainage Plans;

ii. The Developer shall clean all existing drains prior to the start of Construction Work in accordance with Section 202 of the CDOT *Standard Specifications*. The Developer shall keep all existing drains used for temporary drainage in operating condition during Construction Work; and

iii. The Developer shall design temporary drainage structures in accordance with the CDOT *Detour Drainage Structure Design Procedure.*

e. Sub-Drainage Systems

i. Sub-drainage systems (e.g., underdrains) shall be designed in accordance with the CDOT *Drainage Design Manual*. Sub-drainage systems may be discharged to the stormwater system in compliance with regulations for groundwater discharge and control of water quality. The Developer shall preserve the capacities and functionality of existing underdrains encountered during construction;

ii. Groundwater is anticipated to be encountered during the Construction Work. The Preliminary Subsurface Investigation is provided in Schedule 29 Reference Documents; and

iii. Wells and springs may exist within the Construction Work. The Developer shall protect and maintain the flow quantity, water quality, access, and availability of the wells and springs.

f. Ponds

i. The Developer shall design, construct and locate all ponds to the Ultimate design;

ii. The Developer shall coordinate with the applicable owner the design and construction of access roads to ponds;

iii. All ponds shall adhere to the extended detention basins (EDB) design guidance as defined in the UDFCD *Urban Storm Drainage Criteria Manual*;

iv. The Developer shall adhere to the requirements of Section 37-92-602(8) of the Colorado Revised Statutes for ponds and infiltration facilities. The Developer shall submit to the Department all information required for the statewide notification compliance portal for Acceptance.

Table 8-5 Water Quality and Detention Ponds

Pond Name	I-70 Mainline Station	Facility Type
Brighton West	2000+00	Flood Control Pond
Brighton East	2012+00	Flood Control Pond
York East	2028+00	Flood Control Pond
Steele West	2050+00	Flood Control Pond
Steele East	2055+00	Flood Control Pond
Steele North	2055+00	Flood Control Pond
Colorado North	2080+00	Flood Control Pond
Colorado South	2080+00	Flood Control Pond
Quebec North	2185+00	Water Quality Pond
Havana North #1	2292+00	Water Quality Pond
Havana North #2	2292+00	Detention Pond
Havana South	2292+00	Water Quality and Detention Pond
Onsite North	Race Court and Brighton Boulevard	Water Quality and Detention Pond

v. All ponds shall include the following:

A. A six foot minimum width concrete trickle channel with mountable curb to convey nuisance flows from inflow locations to the primary low-level outlet and shall be designed for maintenance equipment loads;

B. Pre-sedimentation forebay and micro pool;

C. Outlet structure shall be flush with the side slope with trash rack;

D. Grades within the basin shall not be less than 0.5 percent unless Accepted by the Department;

E. Outfalls flowing into a pond shall be placed no less than 6 inches above the bottom of pond; and

F. Emergency spillway.

vi. The Developer shall design and construct flood control ponds adjacent to the Lowered Section to capture and convey the 100 year flood before entering the I-70 Mainline. Flood Control Ponds shall not include the pre-sedimentation forebay and micro pool;

vii. The Developer shall design and construct water quality and detention ponds to provide for the full WQCV plus the 10 year detention volume for the minor storm, and one-half of the WQCV plus the 100 year detention volume for the major storm event;

viii. The Developer shall design and construct water quality ponds to provide for the full WQCV. Alternate PSQFs for water quality ponds, as shown in CDOT *Erosion Control and Stormwater Quality Guide*, may be used with Acceptance from the Department;

ix. The Developer shall provide the following:

A. 12 foot minimum width access road for maintenance equipment to the inlet and outlet structure;

B. 12 foot minimum width access road around the top of the pond, or turn around area suitable for maintenance equipment;

C. A staging area suitable for maintenance Activities; and

D. Fall protection, where required.

x. The elevation of the emergency spillway or overflow structure shall be at the elevation of the routed 100 year water surface. The emergency spillway or overflow structure shall have the capacity to convey the routed 100 year peak discharge. Embankments shall provide a minimum of one foot of freeboard above the routed 100 year water surface elevation through the emergency spillway;

xi. All ponds shall be installed outside the 100 year floodplain boundary;

xii. The low-level outlet of the outlet structure shall include a debris rack with a total opening area at least twice the area of the low-level outlet;

xiii. Detention basin slopes and bottom shall be protected against erosion from inflows and circulation within the basin;

xiv. Slopes of earth embankments for detention facilities steeper than 4:1 will not be allowed unless Accepted by the Department. Slopes in ponds shall be planted with a seed mix and protected by a soil retention covering per CDOT *Standard Specifications*.

xv. Existing unintended detention storage volume at the entrance to existing Cross Drains or Storm Drain systems shall not be considered to reduce peak discharges downstream;

xvi. Groundwater elevation plans shall be created by the Developer at all pond locations. The plans shall show the pond, location of borehole, existing and proposed contours, groundwater elevation, and depth to groundwater. If groundwater is encountered, measures shall be taken (e.g., perimeter underdrain system or impermeable liner) to prevent groundwater seepage into the pond. Groundwater shall not pass through the forebay, trickle channel or micropool; and

xvii. All pond design calculations, geometry, and details shall be provided to the Department as part of the Drainage Report.

g. Bridges and Deck Drainage

The Developer shall provide deck drainage systems for bridges when the maximum allowable flow spread for the design storm is exceeded. Inlets shall limit flow across the expansion device to less than one cubic feet per second (cfs) for the 10 year storm. Bridge deck drainage systems shall be designed in accordance with the FHWA HEC-21 *Design of Bridge Deck Drainage*. See Schedule 10, Section 13 Structures for more information regarding bridge deck drainage requirements.

8.4.5 Stormwater Pump Stations

a. The use of pump stations shall be permitted where stormwater removal is not feasible, as Approved by the Department; and

b. The Developer shall comply with the following requirements in relation to the design of permitted pump stations:

i. The pump stations shall be designed for the 100 year, two hour event;

ii. The design shall comply with the HEC-24, Highway Stormwater Pump Station Design;

iii. The extent of the 100 year storm shall be determined and safeguards against flooding shall be provided;

iv. A wet well shall be incorporated with the pump station design. The maximum water level in the wet well shall be more than one foot below the lowest pavement elevation;

v. The configuration shall provide for screening out debris and a minimum of three pumps;

vi. Pump equipment and controls shall be explosion proof, corrosion resistant and appropriate for the application;

vii. Backup systems for power, control and pumping shall be provided;

viii. The design shall include access for ordinary maintenance, provisions for replacing pumps, and a minimum of two parking spaces;

ix. The pump house shall have locked doors, fence and gate for security, and an adequate ventilation system;

x. The design shall eliminate the need for confined space entry as defined by Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH);

xi. The site layout shall adhere to the aesthetic requirements, as provided in Schedule 10, Section 14 Landscaping and Aesthetics;

xii. The design of the pump facility shall minimize noise to adjacent sensitive receptors;

xiii. The installed equipment shall be certified and tested prior to being placed in service;

xiv. The design shall include operation and maintenance manuals for the facility; and

xv. Utility service for the pump stations shall be as required by Schedule 10, Section 4 Utilities.

8.4.6 Irrigation Facilities

The Developer shall coordinate all modifications, crossings and connections to irrigation ditches and shall adhere to ditch company standards and requirements.

8.4.7 Floodplains

a. The Developer shall coordinate all impacts to Federal Emergency Management Agency (FEMA) regulated floodplains and changes to bridges and Cross Drains located in FEMA regulated floodplains with the Department, FEMA, UDFCD, and the Local Agency floodplain administrator;

b. The Developer shall comply with local floodplain development Permits as well as applicable National Flood Insurance Program requirements;

c. As required by the FEMA or Local Agency floodplain administrators, the Developer shall develop hydraulic models of the waterways and crossing structures to demonstrate hydraulic performance of new structures and existing structures;

d. The Developer shall apply for, obtain, and submit Conditional Letters of Map Revision (CLOMR) and Letters of Map Revision (LOMR) to the Department, for Acceptance, if required;

e. The Developer shall be responsible for all FEMA and other agency fees;

f. The Developer shall obtain floodplain development Permits as required by the Local Agencies; and

g. The Developer shall be responsible for and comply with submittal schedules as required by all reviewing agencies.

8.4.8 Storm Water Management Plan Updates

a. The SWMP shall be updated and submitted to the Department to document changes to design and construction Activities;

b. To verify compliance with 208.04(e) of the CDOT *Standard Specifications*, the Developer shall submit plan drawings and electronic files of the SWMP Site Map which show the current areas of erodible earth material exposed at one time by clearing and grubbing, and earthwork operations once per month. The format of the electronic files must allow for the area to be calculated and verified (for example MicroStation or Adobe Pro with appropriate polygon shapes);

c. The Developer shall submit updates to the SWMP Site Map monthly, revising to incorporate the progress of the Construction Work; and

d. The surface area of erodible earth material exposed at one time by clearing and grubbing and earthwork operations shall not exceed 34 acres as required by Section 208.04(e) of the CDOT *Standard Specifications*. The Developer may request permission in writing to exceed the 34 acre maximum. This request must include information on the Developers plan and the resources that will be utilized to ensure compliance with the requirements of the CDPS-SPC and Section 208 of the CDOT *Standard Specifications*. Permission to exceed the 34 acre maximum will be given at the Department's discretion and may be withdrawn at any time if the Developer fails to meet the requirements of Section 208 of the CDOT *Standard Specifications*.

8.4.9 Area Specific Drainage Requirements and/or Information

a. Offsite Outfall System

The Developer shall design, construct and install the necessary drainage infrastructure required to protect the Lowered Section of the I-70 Mainline between Brighton Boulevard and Dahlia Street from the 100 year event. No Offsite flow shall be allowed to drain into the Lowered Section.

b. Onsite Outfall System

The Developer shall design, construct and install the necessary drainage infrastructure required to drain the Lowered Section of the I-70 Mainline. The only tributary area allowed to drain to the low point will be the roadway and associated ramps located within the Lowered Section.

c. 46th Avenue Drainage Design - Brighton Boulevard to Dahlia Street

The Developer shall design, construct and install the necessary drainage infrastructure required to meet CCD criteria and prevent Offsite flow from draining into the Lowered Section of the I-70 Mainline.

d. I-70 Mainline Restriping - I-25 to Brighton Boulevard

The segment of I-70 Mainline between I-25 and Brighton Boulevard will consist of restriping that substantially reduces the shoulder of the I-70 Mainline. The inlets required to meet spread criteria shall be incorporated by the Developer into the drainage design.

e. Safeway

The Developer shall design, construct, install, and coordinate with Safeway to replace the existing water quality ponds that will be removed with the widening of the I-70 Mainline to the southeast of Colorado Boulevard.

f. Storm Drain over the Lowered Section near York Street

The Developer shall perpetuate the flow in the existing Storm Drain located in York Street over the Lowered Section, and tie back into the existing Storm Drain on the north side of I-70 Mainline.

g. Sand Creek

The Developer shall design and reconstruct the overflow channel for Sand Creek adjacent to the south side of the I-270 flyover. The Developer shall coordinate with CCD, UDFCD and Local Agency floodplain administrator.

h. Groundwater

The Developer shall provide the necessary analysis and design for temporary dewatering during construction and permanent treatment of groundwater for the Project. Additional information regarding groundwater conditions and requirements are included in Schedule 17 Environmental Requirements.

i. Cover

The Developer shall design, construct and install the necessary drainage infrastructure required to drain the Cover and protect the Lowered Section of the I-70 Mainline between Columbine Street to Clayton Street from the 100 year event. Additional information and requirements regarding the Cover are included in Schedule 10, Section 12 Cover MEP System.

j. Micro Tunneling and Pipe Jacking

Micro tunneling or pipe jacking shall be permitted in areas where open cut installation of Storm Drains and Cross Drains is prohibitive. The use of rectangular pipe is prohibited. The Developer shall:

i. Consider the use of steel, concrete, or centrifugally cast fiberglass-reinforced, polymer mortar pipe. Pipe material shall be submitted by the Developer to the Department for Acceptance.

ii. Submit to the Department, for Acceptance, the materials, means, and methods of installation, including but not limited to the following:

A. Plan and profile with all Utilities shown and labeled with appropriate Utility ID number. All clearances between Storm Drains or Cross Drains and Utilities shall be clearly labeled;

B. Jack and boring pit locations;

C. Excavation Material Management Plan;

D. Traffic Control Plan;

E. Dewatering Plan; and

F. Quality Control Plan;

8.5 Construction Requirements

8.5.1 The Developer shall be aware that the Project is within two large existing flood-prone basins; the Montclair Basin and Park Hill Basin. The Developer shall be responsible for protecting and preserving public and private property from damage resulting directly or indirectly from

stormwater runoff along or adjacent to the Site during construction of all improvements, including upstream and downstream properties.

8.5.2 The Developer is advised to coordinate with entities, including but not limited to the UDFCD for flows that affect drainage within the Site. The Developer shall evaluate construction methods and staging during the design phase and include provisions to maintain positive drainage at all times during construction.

8.5.3 The Developer shall:

a. Store materials in areas where damage from flood waters is not likely to occur;

b. Not place fill or decrease conveyance capacity of stormwater flow paths without first installing conveyance, either temporary or permanent, to adequately perpetuate the flows in a historical manner and condition consistent with historical flows;

c. Maintain such conveyance for all existing flow areas and temporary and permanent conveyance facilities constructed as part of the Project;

d. Include necessary upstream collection facilities and extend the conveyance system downstream to a reasonable outfall location; and

e. Not divert flows from historical patterns until downstream facilities, either temporary or permanent, are in place to safely convey flows to an acceptable outfall location.

8.5.4 The Developer shall sequence construction of drainage features, including but not limited to inlets, lateral connections, storm drains, channels, and reinforced concrete boxes, so they can be connected to their appropriate outfall to convey flows as designed. If construction of the outfall cannot be completed before direct connection of upstream drainage features, the Developer shall provide temporary flow conveyance.

8.5.5 The Developer assumes full responsibility for flood damage or impacts created as a result of the Construction Work.

8.5.6 The Developer shall survey PSQFs according to Section 6.1.3 of the CDOT *Survey Manual* to confirm the design volume has been provided during construction and documented in the As-Built plans. The Developer shall also submit a Pond Certification Letter stamped by a professional engineer that summarizes all pertinent information. This form shall be submitted prior to final seeding of the facility. The Developer shall map for inclusion into CDOT's Geographic Information System, all new and existing (remaining) outfalls.

8.5.7 Pipe Material Selection Guide

a. The Developer shall comply with the CDOT *Pipe Material Selection Guide*; and

b. Clarifications of the CDOT *Pipe Material Selection Guide* are as follows:

i. Trial installations are not allowed on the Construction Work;

ii. The Developer shall sample soil and water;

iii. References to "Project Manager" in the Guide shall be the Developer;

iv. The Developer shall provide a sampling schedule for pipe selection for Department, for Information, 30 Calendar Days after issuance of NTP 1;

v. Pipe material selection shall be submitted as part of the Drainage Reports;

vi. Aluminum alloy pipe shall not be used; and

vii. Storm Drains that are both parallel to and within the strap zone of retaining walls shall be solid wall plastic conduit.

8.6 Drainage Reports

8.6.1 Master Drainage Report

The Developer shall prepare a Master Drainage Report and submit to the Department, for Acceptance, concurrent with the Preliminary (30% Level) Plan Package. The Master Drainage Report shall show how the Developer's design meets the Reference Design and Ultimate configuration, as discussed in this Section.

8.6.2 Interim Drainage Reports

The purpose of an Interim Drainage Report is to actively capture and document all changes to design between the Master and Final report submittals. Interim Drainage Reports shall be submitted by the Developer to the Department for Acceptance. The Developer shall create and include an index of changes to design with each Interim Drainage Report submittal.

8.6.3 Final Drainage Reports

The purpose of the Final Drainage Report is to integrate all Accepted Interim Drainage Reports into one stand-alone report for the Project. The Final Drainage Report shall be prepared by the Developer and submitted to the Department for Acceptance prior to Substantial Completion. The Developer shall include a summary index that incorporates all interim report changes with the Final Drainage Report submittal. No addenda to the Final Drainage Report shall be permitted;

8.6.4 Drainage Reports shall follow the documentation procedure in Chapter 4 of the CDOT *Drainage Design Manual* and shall include the following:

a. Basic design data, design assumptions, hydrologic and hydraulic methodologies, assumptions, model inputs and outputs, detailed calculations, computations, and computer printouts, relevant design criteria, circumstances influencing design, discussion of all drainage issues and drainage facilities, appropriate maps, figures, and plans;

b. Rationale for sizing and selection of all drainage elements, including catch basins, Storm Drain systems, Cross Drains, ditches, swales, PSQFs, detention facilities, and pipe materials selection;

c. Hydraulic data sheets with a summary of hydraulic design information for each Storm Drain and Cross Drain;

d. A delineation of contributing basins, existing drainage patterns for both highway and cross-drainage flows, drainage parameters, inflow hydrographs for detention basins, detention basin sizing, discharge characteristics, discharge hydrographs for detention basins, detention times, and other information necessary for the design of the drainage system. All drainage reports shall include documentation of tributary flows from areas outside of each construction segment, as defined by the Developer;

e. Documentation that the proposed runoff will be controlled and treated in accordance with this Section and all drainage and water quality Permits;

f. Documentation of existing drainage discharge rates, outfall locations and pond release rates;

g. Documentation of the impact of proposed drainage designs on existing drainage facilities;

h. Documentation of compatibility with the Ultimate design; and

i. Calculations, analysis, and all related information used in developing conclusions and recommendations for PSQFs in accordance with CDOT NDRD requirements.

8.6.5 In addition to the documentation procedure in Chapter 4 of the CDOT *Drainage Design Manual*, the Developer shall follow the report outline below. The section and subsection headings shall be maintained at a minimum. If a section or subsection is not used, the reason it is not applicable to the Project shall be specified. New sections or additional subsections shall be added as necessary to fully document the drainage design:

a. Drainage Report Outline;

i. Introduction

A. Location of improvements;

B. Description of improvements; and

C. Discussion of drainage investigation.

ii. Cross Drainage, Drainageway, and Irrigation Ditch Crossings

A. Location and general discussion;

B. Hydrology and design flow development;

C. Information sources;

D. Pipe material selection

E. Agency coordination (i.e. UDFCD, Local Agencies);

F. Description of structural design (i.e. for non-CDOT standard CBCs);

G. Hydraulic design;

H. Groundwater and sub-drainage features;

I. Drainageways and floodplains;

J. Scour analysis; and

K. Bank stabilization.

iii. Roadway Drainage Systems

A. General discussion

B. Design coordination

(I) Adjacent segments; and

(II) Agency coordination.

C. Drainage Basin Delineations & Characterization

(I) Existing basins; and

(II) Proposed basins.

D. Hydrology and Design Flow Development

E. Pavement, Median and Roadside Drainage

(I) Inlet/Catch basin spacing design;

(II) Storm Drain design;

(III) Roadside ditch and channel design; and

(IV) Erosion control design.

iv. Permanent Stormwater Quality Facilities

A. Assumptions and methodologies

(I) Allowable release rate discussion

B. Hydrology and Hydraulics

(I) Storage and outlet design documentation

C. Adherence to the CDOT MS4 Permit and NDRD requirements.

v. Appendices

A. Hydrologic Analysis

(I) Onsite hydrology;

(II) Offsite hydrology;

(III) Precipitation data;

(IV) Soil survey;

(V) Land use; and

(VI) FEMA maps.

B. Hydraulic Analysis

(I) Spread width, Inlet and Storm Drain calculations;

(II) Roadside ditch and channel calculations;

(III) Hydraulic grade line calculations;

(IV) Drain outfalls, scour and erosion control calculations; and

(V) Groundwater and sub-drainage systems.

C. Permanent Stormwater Quality Facilities

(I) Extended detention basin calculations;

(II) Stage storage calculations;

(III) Trickle channel calculations; and

(IV) Water quality structure calculations.

D. Basin Maps

(I) Existing and proposed Onsite basin maps; and

(II) Offsite Basin maps (full size 22 inch x 34 inch sheets).

vi. References.

b. The Developer shall submit to the Department one hard copy of the Master Drainage Report, one hard copy of all Interim Drainage Reports, and three hard copies of the Final Drainage Report for Acceptance. All Drainage Reports shall be signed and sealed;

c. The Developer shall submit, to the Department, an electronic copy of all signed and sealed drainage reports in PDF format; and

d. The Final Drainage Report shall include electronic copies of all computer analysis input and output files in the native file format.

8.7 Water Quality Reports

8.7.1 The Developer shall prepare Water Quality Reports to document permanent water quality design decisions for compliance with the CDPHE. All decisions shall adhere to the NDRD program as part of CDOT's overall MS4 Permit;

8.7.2 The Developer shall prepare a Master Water Quality Report and submit to the Department, for Acceptance, concurrent with the Preliminary (30% Level) Plan Package. The Master Water Quality Report shall show how the Developers design meets the Reference Design and Ultimate configuration, as discussed in this Section.

8.7.3 The purpose of an Interim Water Quality Report is to actively capture and document all changes that affect permanent water quality between the Master and Final report submittals. Interim Water Quality Reports shall be submitted by the Developer to the Department for Acceptance. The Developer shall create and include an index of changes to design with these reports to reflect the content of the Final Water Quality Report;

8.7.4 The purpose of the Final Water Quality Report is to integrate all Accepted Interim Water Quality Reports into one stand-alone report for the Project. The Final Water Quality Report, shall be prepared by the Developer and submitted to the Department for Acceptance prior to Substantial Completion. The Developer shall include a summary index that incorporates all interim report changes with the Final Water Quality Report submittal. No addenda to the Final Water Quality Report shall be permitted;

8.7.5 The Water Quality Reports shall reference the applicable drainage report for all technical aspects and design calculations;

8.7.6 The Water Quality Reports shall include the following:

a. All assumptions, circumstances influencing design, applicable design standards and/or requirements, and design criteria-related decisions;

b. Design decisions shall be documented and shall be based on sound engineering principles;

c. All related references including maps, figures, and plans shall be provided in the appendix;

d. Documentation of tributary flows from areas outside of each defined construction segment; and

e. An exhibit showing the Construction Work in relation to the MS4 boundary area.

8.7.7 The Developer shall prepare an NDRD exhibit to be included with all Water Quality Reports. The NDRD exhibit shall include the following:

a. A delineation of each basin with a colored, solid-filled, hatch pattern. Each basin shall be tributary to a specific PSQF. Provide different colors for each PSQF basin. These basins shall incorporate the sub-basins found in the Drainage Reports;

b. A label for each water quality basin. Include the typical basin designation circle label. Include within the circle the water quality basin ID, the basin area, and the impervious area with that basin. Provide a legend to describe the basin designation label;

c. A label for the proposed PSQFs serving each basin. The Developer shall ensure that the location of the PSQF matches the proposed locations found in the construction drawings;

d. Flow direction arrows;

e. A delineation of disturbed areas for the Construction Work; and

f. A table with six column headings. The column headings shall be; Basin, Color, Basin ID, Type of PSQF used to Treat Area, Required Impervious Area to be Treated, Increased Impervious Area Treated, and Comments. At the bottom of the table sum the columns for increased impervious area to be treated and the actual impervious area treated.

8.7.8 The Developer shall submit to the Department one hard copy of all Interim Water Quality Reports and three hard copies of the Final Water Quality Report for Acceptance. All Water Quality Reports shall be signed and sealed;

8.7.9 The Developer shall submit one electronic copy of all signed and sealed Water Quality Reports in PDF format; and

8.7.10 The Water Quality Reports shall follow the report outline below. New sections or additional subsections shall be added as necessary to fully document the design:

a. Water Quality Report Outline

i. Table of Contents

ii. Introduction

A. Vicinity Map;

B. Site location, stationing;

C. State highway number;

D. Name of receiving waters;

E. Location of existing and proposed outfalls;

F. Geographic reference (county, nearest town); and

G. Jurisdictional MS4 boundary areas.

iii. Discussion of CDOT MS4/NDRD Requirements

A. Discussion of how proposed PSQFs satisfy CDOT's MS4 requirements;

B. Site map showing locations of PSQFs;

C. Relationship of PSQFs to major drainageway and outfall systems plans;

D. Detailed description, design criteria, and references to specifications and technical details of PSQFs as documented in the applicable Drainage Reports;

E. Detailed descriptions, design criteria, and locations of stream stabilization measures to be implemented;

F. Design objectives;

G. Treatment options;

H. Expected pollutant removal rates;

I. Existing water quality features that will be abandoned, reconfigured, or incorporated into a new design;

J. ROW needs and/or concerns;

K. Recommended design; and

L. Maintenance and operation requirements, inspection protocols, and maintenance schedule.

iv. The following topics shall be addressed in detail:

A. Description of project and land disturbance in acres;

B. What area (in acres) is required to be treated, what area (in acres) of treatment is provided, what area (in acres) is not treated, and what area (in acres) is treated in addition to what is required. The discussion shall distinguish between CDOT MS4 area and non-CDOT MS4 area. Include this information in the report and as a note on the NDRD exhibit;

C. Detailed description, design criteria, justifications, decision making process (why a permanent BMP was chosen over another), location of permanent BMPs to be implemented, and analysis as to how permanent BMPs (combination or individual) satisfy the current CDOT NDRD requirements; and

D. Provide the certification number for the CDPS Construction Permit for the Construction Work.

v. Maintenance and Operation

A. Narrative description of the facility

Example: Extended detention pond with a single cell outlet structure with an orifice plate which is designed for a 40 hour drain time. Three inlets drain into the basin which has a concrete lined forebay with grouted riprap berm. The forebay is designed to drain within five minutes and keep out large floatable/debris.

B. Narrative description of maintenance access to the facility

Example: maintenance access off of southbound I-25 before guardrail or take ramp from southbound I-25 to westbound Speer. Parking is from the shoulder.

C. Narrative description of what maintenance work will need to be done and at what frequency to ensure continued effectiveness of the facility.

Example:

(I) Mowing basin to keep vegetation controlled so water can continue to flow unhindered. Remove vegetation from facility to keep from re-clogging grates and orifice plate;

(II) Clean trash rack/grates of debris and dispose of off of PSQF site;

(III) Clear orifice plate holes so water can continue to flow;

(IV) Remove sediment from basin when reaches lowest orifice hole or blocking forebay outlet pipe. Can use hand shovels, bobcats/skid steers;

(V) Remove sediment off of PSQF site to keep from re-polluting the pond;

(VI) Re-seed as necessary to keep area stable of erosion;

(VII) Add additional erosion control items to keep area stable; and

(VIII) Tighten/replace trash rack bolts and screens as necessary to keep structure in working order.

D. Documentation of commitments from responsible agency (such as Intergovernmental Agreements, Memoranda of Understanding, etc.) or owner to maintain the PSQF's shall be required and included with the Final Water Quality Report.

vi. Appendix

A. Construction Work in relation to MS4 boundary area exhibit; and

B. NDRD Exhibit

8.8 Drainage Plans

8.8.1 The Developer shall prepare plans for all drainage related facilities for the Construction Work in a format that follows the documentation procedure in Chapter 4 of the CDOT *Drainage Design Manual,* CDOT *CADD Manual* and CDOT *Drafting Manual*;

8.8.2 The Developer shall submit all applicable plans with each drainage report; and

8.8.3 Plans shall be submitted with changes to design. The Developer shall include the following for all drainage plan deliverables:

a. Plan View

i. Provide the location of all existing and proposed drains. Provide a label for each proposed drain location. The Developer shall establish a labeling system that is specific to each proposed storm drain system and provide a table to summarize all pertinent information. The table shall include the drain line and sheet number where the profile can be found;

ii. Provide the location of all existing and proposed inlets, manholes, end sections, and outlet protection. Provide a label for each proposed inlet, manhole, end section, and outlet protection. Include a table that summarizes all pertinent information. The table shall include the label ID, station and offset, item, length, pay depth, and notes;

iii. Provide all existing and proposed grading;

iv. All Utilities and As-Built information for relocated Utilities shall be accurately shown;

v. Provide location of existing and proposed ROW lines;

vi. Label locations of all drains to be removed or abandoned with flowfill. Include description and length of drain; and

vii. Provide locations of all proposed permanent underdrains. Include locations of existing underdrains to be utilized with the Project as discovered during Construction Work. Provide a label for each underdrain location, clean out, fittings, and outlet. The Developer shall establish a labeling system that is specific to each underdrain system and provide a table to summarize all pertinent information. The table shall include the drain line and sheet number where the profile can be found and include the label ID, station and offset, item, length, and notes.

viii. Groundwater elevation plans shall be created by the Developer at all pond locations

b. Profiles

i. Provide profiles for all proposed Storm Drains. Include the label ID from plan view sheets, station and offset, invert elevations, rim elevations, structure depth, slopes, sizes, material, existing and proposed finished grade lines, the design flow for the 10 year and 100 year event, and the calculated HGL for the 10 year and 100 year event. All utilities shall be accurately shown and labeled with appropriate Utility ID number. All clearances between Storm Drains and Utilities shall be clearly labeled;

ii. Provide profiles for all proposed Cross Drains. Include the label ID from plan view sheets, station and offset, invert elevations, slopes, sizes, material, existing and proposed finished grade lines, the drainage area of contributing basin, the design flow for the 10 year and 100 year event, the calculated hydraulic grade line (HGL) for the 10 year and 100 year event, and headwater elevation. All Utilities shall be accurately shown and labeled with appropriate Utility ID number. All clearances between Cross Drains and Utilities shall be clearly labeled;

iii. Provide profiles for all underdrains. Include the label ID from plan view sheets, station and offset, invert elevations, slopes, sizes, material, and existing and proposed finished grade lines. All Utilities shall be accurately shown and labeled with appropriate Utility ID number. Underdrain profiles may be combined with Storm Drain and Cross Drain profiles where applicable; and

iv. Provide location of design groundwater elevation in all profiles located within the Brighton Boulevard to Colorado Boulevard Construction Work.

c. Include details for all non-standard CDOT items.

d. Details for EDB

i. Provide each EDB in plan view. Provide existing and proposed contours that define limits of overall facility. Include access roads, overflow location or structure, forebay, trickle channel, micropool, and outlet structure. Include locations of all property lines. Include point labels to define location and elevations within the facility;

ii. Provide a table summarizing each point label. The table shall include the point label, station and offset, northing, easting, elevation and notes;

iii. Provide a cross section of the EDB from where flows enter the pond to the outlet structure. Label elevations for the WQCV, 10 year, and 100 year events. Include slopes and elevations of all features;

iv. Provide a geometry plan of the EDB from where flows enter the pond to the outlet structure. Include access roads;

v. Provide specific details for the forebay, trickle channel, micropool, and outlet structure; and

vi. All Utilities shall be accurately shown and labeled with appropriate Utility ID number.

8.8.4 Temporary Drainage Plan

a. The Developer shall prepare Temporary Drainage Plans for the Construction Work. Phasing plans shall be used as the basis for the plans and shall be submitted to the Department for Information;

b. The Developer shall provide the location of all temporary connections to any drainage system. The Developer shall provide a label for each proposed drain location. The Developer shall establish a labeling system that is specific to each proposed storm drain system and provide a table to summarize all pertinent information. The table shall include the drain line and sheet number where the profile can be found; and

c. Plans shall be submitted with changes to design.

8.8.5 Pond Certification Letter

a. The Developer shall prepare and submit to the Department a Pond Certification Letter signed and stamped by a Colorado licensed professional engineer. This form shall be completed before final seeding and submitted for Information prior to Acceptance of the As-Built documents; and

b. The form shall include the following information for each pond:

i. Include the statement "I (professional engineer), certify that I have reviewed all As-Built survey information provided by (Developer) for (pond name) within the Project and hereby certify that the pond was constructed in accordance with the approved design plans."

ii. Provide a pond volume table summarizing the WQCV, 10 year volume plus WQCV and the 100 year volume plus one half the WQCV. Identify the design volume, design elevation, As-Built volume and As-Built elevation for each of the items listed;

iii. Provide a pond elevation table summarizing the design and As-Built elevation for the emergency overflow, top of pond, inlet, and outlet;

iv. Provide a pond release rate table summarizing the design and As-Built 10 year and 100 year release rates and flow over spillway. Include the length of spillway for design and As-Built conditions;

v. Applicable As-Built plan, profile and detail sheets shall be attached with the Pond Certification Letter: and

vi. The Pond Certification Letter shall be submitted to the Department with all changes to design.

8.9 As-Built Documents

All reports, documents, plans and other information required to be prepared in accordance with this Section shall be updated based on surveys of what was actually built in the field and submitted to the Department for Acceptance.

8.10 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the specified timeframes:

Table 8-6 Deliverables

Deliverable	Information, Acceptance or Approval	Schedule
Use of stormwater pump station	Approval	As required
Final Drainage Report	Acceptance	Prior to Substantial Completion
Final Water Quality Report	Acceptance	Prior to Substantial Completion
Interim Drainage Reports	Acceptance	Concurrent with Final (100% Level) Plan Package and RFC Documents
Interim Water Quality Reports	Acceptance	Concurrent with Final (100% Level) Plan Package and RFC Documents
Master Drainage Report	Acceptance	Concurrent with Preliminary (30% Level) Plan Package
Master Water Quality Report	Acceptance	Concurrent with Preliminary (30% Level) Plan Package
Pond Certification Letter	Information	Prior to Final Acceptance
Temporary Drainage Plans	Acceptance	Prior to Release for Construction
CLOMR	Acceptance	Prior to RFC Documents
LOMR	Acceptance	Prior to Substantial Completion
SWMP	Acceptance	Prior to RFC Documents
SWMP Site Map Updates	Acceptance	Monthly during the Construction Period
Sampling schedule for pipe selection	Information	30 Calendar Days after issuance of NTP 1
Micro tunneling and/or pipe jacking materials means and methods of installation	Acceptance	Prior to RFC Documents
Pipe connections to manholes with material other than concrete	Information	Prior to RFC Documents
Information required for the statewide notification compliance portal for Acceptance	Acceptance	Prior to Final Acceptance

8.11 Appendices

Appendix A Project Special Provisions

Appendix A
Project Special Provisions

The following special provisions supplement or modify and take precedence over the Standard Specifications. The provisions of Appendix A to Schedule 10A Applicable Standards and Specifications apply to these Project Special Provisions.

PROJECT SPECIAL PROVISIONS

REVISION OF SECTION 603
CULVERTS AND SEWERS

The following specifications modify and take precedence over the Standard Specifications. The requirements of Schedule 10 Section 6 apply to these Project Special Provisions.

Subsection 603.07(a) shall include the following:

Joints for all circular and elliptical reinforced pipe shall be made with confined rubber gaskets. Concrete collars shall be required at all nonstandard joints (not tongue and groove or bell and spigot), and at all connections to existing pipe.

Subsection 603.07(c) shall include the following:

All welding of pipe and fittings for plastic conduit shall be performed by qualified and certified personnel trained in Extrusion Welding. Certifications shall be provided to the Department prior to performing any welding for the Project

In order to limit thermal expansion, all connections made to concrete structures shall be made a minimum of 24 hours after the pipe has been installed and backfilled.

9. ROADWAY

9.1 General

The Developer shall design and construct all roadways, and associated roadway items, including earthwork, pavements, curbs, medians, islands, barriers, guardrail, fence, incidentals and other roadside items.

9.2 Applicable Standards

All Construction Work required to be performed by the Developer pursuant to this Section shall comply with Schedule 10A Applicable Standards and Specifications, the relevant requirements listed in this Section, Good Industry Practice, and the following:

a. Appendix A Roadway Design Criteria; and

b. Conform to the Roadway Typical Sections as provided in Schedule 10B Contract Drawings.

9.3 Design Requirements

9.3.1 Local Agency Roadways shall be designed and constructed according to the Local Agency's standards and requirements. Where particular Elements of design and construction are not covered by Local Agency standards, the applicable Federal and State standards shall apply. With the exception of the I-70 Mainline, Local Agency standards shall also be applied to all CDOT Roadways between the back of curb and the ROW line. In addition to Local Agency standards, the Developer shall follow Local Agency Municipal Codes and Ordinances as applicable to the Project. Applicable Codes and Ordinances include, but may not be limited to the following:

a. Revised Denver Municipal Code Ordinance, Section 49-141: Location and width of curb cuts;

b. Revised Denver Municipal Code Ordinance Section 49-142: Alteration of existing curb cuts;

c. Denver Zoning Code 10.4.5.2A and B, Vehicular Access: Access from Public ROW;

d. Denver Zoning Code 10.4.7.5, Amount Required: Amount of off-street loading and maneuvering space; and

e. Denver Zoning Code, On-site Design: Design of drive isles, parking stalls and setbacks.

9.3.2 The Developer shall design and construct alleyway connections in accordance with the City and County of Denver (CCD) *Transportation Standards and Details*.

9.3.3 Intelligent Transportation Systems (ITS) ITS and Electronic Toll Collection (ETC) infrastructure shall comply with the requirements in Schedule 10, Section 3 ITS and Tolling Equipment. Within the full reconstruction limits, install ETC and ITS infrastructure with the accommodation for addition of a future Tolled Express Lane.

9.3.4 The Developer's design shall adhere to the commitments established within the I-70 East EIS. The number, type, and width of traffic lanes, interchange locations, highway and local roadway access are specified in the I-70 East EIS and constitute the Ultimate configuration. All roadway infrastructure Elements shall be designed and constructed to meet the requirements set out in this Section and shall accommodate, to the extent practical, the Ultimate configuration. Considerations include horizontal and vertical geometry, vertical clearances and cover over underground structures, and superelevation.

9.3.5 The Roadway Typical Sections represent a graphical detail of the roadway section widths and components listed in Appendix A Roadway Design Criteria. The Roadway Typical Section information shall form the basis of the Developer's design for typical lane and shoulder widths, curb and sidewalk locations and cross slopes.

9.3.6 New traffic signals shall be provided at intersections as required in Schedule 10, Section 11, Signing, Pavement Markings, Striping, Signalization, and Lighting. Application of roadway and pedestrian sight distance triangles required for the design of CCD traffic signal placement,

intersecting roadways, driveways and alleyways, shall in accordance with the CCD *Transportation Engineering Plan (TEP) Review Submittal Requirements.*

9.3.7 For reference and subject always to Section 3 of the Project Agreement, the Reference Documents include the Interstate Access Request (IAR). It shall be the Developer's responsibility to modify and obtain required Governmental Approvals and Permits should alternate design concepts be utilized by the Developer.

9.4 Construction Work Requirements

9.4.1 I-70 Mainline

a. Pecos Street to Brighton Boulevard (eastbound): Signing, Restriping, ETC and ITS Infrastructure

i. Utilizing the existing pavement width of the I-70 pavement, the Developer shall provide a new single eastbound Tolled Express Lane beginning approximately 2,100 feet west of Washington Street and extending east to the point of full I-70 Mainline reconstruction at Brighton Boulevard. Tolled Express Lane signage and ITS installation shall begin between Pecos Street and I-25 in accordance with the requirements of Schedule 10, Section 3 ITS and Tolling Equipment.

ii. The eastbound I-70 Mainline shall meet the following minimum design requirements:

A. Provide an inside shoulder;

B. Provide a single Tolled Express Lane;

C. Provide a buffer between Tolled Express Lane and adjacent General Purpose Lanes;

D. Maintain current number of existing General Purpose Lanes and auxiliary lanes; and

E. Provide an outside shoulder width meeting the design criteria specified in this Section.

b. I-25 to Brighton Boulevard (westbound): Signing, Restriping, ETC and ITS Infrastructure

i. Utilizing the existing pavement width of the I-70 pavement, the Developer shall provide a single westbound Tolled Express Lane from the point of full I-70 Mainline reconstruction at Brighton Boulevard and extending to approximately 1,100 feet west of Washington Street.

ii. The westbound I-70 Mainline shall meet the following minimum design requirements:

A. Provide an inside shoulder;

B. Provide a single Tolled Express Lane;

C. Provide a buffer between Tolled Express Lane and adjacent General Purpose Lanes;

D. Maintain current number of existing General Purpose Lanes and auxiliary lanes; and

E. Provide an outside shoulder width meeting the design criteria specified in this Section.

c. Brighton Boulevard to Colorado Boulevard: Full Reconstruction of Highway Below Grade

i. The I-70 Mainline shall be reconstructed to provide three General Purpose Lanes and two Ultimate Tolled Express Lanes with associated ITS infrastructure in each direction. The Developer is required to construct one Tolled Express Lane with the accommodation for one additional future Tolled Express Lane. The Developer is

responsible for delineating and striping one Tolled Express Lane, with weave zones, in each direction as part of the Construction Work.

ii. The I-70 Mainline shall be reconstructed to meet the following requirements:

A. Provide an inside shoulder (width to include a future Ultimate second Tolled Express Lane with inside shoulder);

B. Provide a single Tolled Express Lane adjacent to the General Purpose Lanes;

C. Provide a buffer between Tolled Express Lane and adjacent General Purpose Lanes;

D. Provide three General Purpose through Lanes; and

E. Provide an outside shoulder meeting the design criteria specified in this Section.

iii. The Developer shall provide ramp acceleration and deceleration lanes, including continuous auxiliary lanes in both directions, between the Brighton Boulevard and Colorado Boulevard interchanges.

d. Colorado Boulevard to Quebec Street: Full Reconstruction of Highway on alignment

i. The I-70 Mainline shall be reconstructed to provide three General Purpose Lanes and two Ultimate Tolled Express Lanes with associated ITS infrastructure in each direction, extending full reconstruction of the I-70 Mainline to the east side of the new Quebec Street bridge. The Developer is required to construct one Tolled Express Lane with accommodation for one additional future Tolled Express Lane. The Developer is responsible for delineating and striping one Tolled Express Lane, with weave zones, in each direction as part of the Construction Work.

ii. The I-70 Mainline shall be reconstructed to meet the following requirements:

A. Provide an inside shoulder (width to include a future Ultimate second Tolled Express Lane with inside shoulder);

B. Provide a single Tolled Express Lane, adjacent to the General Purpose Lanes;

C. Provide a buffer between Tolled Express Lane and adjacent General Purpose Lanes;

D. Provide three General Purpose through Lanes; and

E. Provide an outside shoulder meeting the design criteria specified in this Section.

iii. The Developer shall provide ramp acceleration and deceleration lanes, including continuous auxiliary lanes in both directions, between the Colorado Boulevard and Holly Street interchanges, and the Holly Street and Quebec Street interchanges.

e. Quebec Street to Chambers Road: Widening and Overlay, Restriping, and ITS Infrastructure

i. The existing I-70 Mainline shall be widened to provide an equivalent number of General Purpose Lanes as currently exist, plus one new Tolled Express Lane with associated ITS infrastructure in each direction.

ii. The Developer shall widen the existing I-70 Mainline to meet the following requirements :

A. Provide an inside shoulder;

B. Provide a single Tolled Express Lane, adjacent to the General Purpose Lanes;

C. Provide a buffer to the adjacent General Purpose Lanes;

D. Provide General Purpose Lanes. Maintain current number of existing General Purpose Lanes;

E. Provide an outside shoulder meeting the design criteria specified in this Section; and

F. Ramp acceleration and deceleration lanes, including continuous auxiliary lanes, shall be provided as follows:

(I) Continuous auxiliary lanes in both directions, between the Quebec Street and Central Park Boulevard interchanges;

(II) Continuous auxiliary lanes in both directions, between the Central Park Boulevard and Havana Street interchanges;

(III) Continuous auxiliary lane in the westbound direction, between the Peoria Street and Havana Street interchanges;

(IV) Continuous auxiliary lane in the eastbound direction, between the Peoria Street and I-225 interchanges; and

(V) Continuous auxiliary lane in the eastbound direction, between the I-225 and Chambers Road interchanges.

iii. The Developer shall provide ramp connections to existing I-70. Number and width of lanes and shoulders shall be as described in Appendix A Roadway Design Criteria.

iv. In areas of asphalt pavement widening, the existing pavement shall be saw cut to a neat line along the final edge of lane line, or in the middle of the final lane location. Saw cuts and pavement joints will not be permitted within the wheel tracks of a final lane location.

9.4.2 I-70 Mainline Interchanges

a. Brighton Boulevard and Interchange Ramp Reconstruction

i. The Brighton Boulevard Interchange shall be reconstructed by the Developer to provide for the lowering of the I-70 Mainline profile to cross under the Union Pacific Railroad (UPRR) 36th Yard, and extend eastward. Ramp connectivity from Brighton Boulevard to I-70 shall be provided as westbound entrance, eastbound exit, westbound exit, and eastbound entrance ramps.

ii. The Developer shall reconstruct the existing diamond interchange at Brighton Boulevard to provide a new diamond interchange in accordance with the following requirements:

A. At the Brighton Boulevard westbound entrance ramp, the Developer shall provide two receiving lanes transitioning to a single-lane ramp with single-lane entrance and acceleration lane;

B. At the Brighton Boulevard eastbound exit ramp, the Developer shall provide a three-lane connection to Brighton Boulevard that includes left turn, left/thru and thru/right lanes while maintaining the existing free-flow right turn to Brighton;

C. At the Brighton Boulevard westbound exit ramp, the Developer shall provide a single-lane exit transitioning to a combined ramp/46th Avenue connection to Brighton Boulevard that includes dual left-turns, a thru and a thru/right lane;

D. At the Brighton Boulevard eastbound entrance ramp, the Developer shall provide a two-lane ramp with two-lane entrance and single-lane acceleration lane; and

E. Reconstruction of Brighton Boulevard, at a minimum, shall match the current existing thru lane and left-turn lane configurations between the I-70 ramps.

Limits of the Construction Work shall extend north from the interchange to 47th Avenue. North of the interchange, up to and including the 47th Avenue intersection shall be reconstructed to provide thru lanes, turn lanes and sidewalk in coordination with CCD's proposed improvements for the National Western Complex. Information on the proposed improvements can be found within Appendix B Planned Denver Projects. South of the interchange, the Construction Work shall add a northbound continuous right turn lane on Brighton Boulevard from 44th Street to the eastbound entrance ramp and new 46th Avenue. Ten foot sidewalks shall be provided on each side of Brighton Boulevard under the I-70 Mainline bridge.

iii. The Developer shall include raised medians to separate the southbound and northbound lanes of Brighton Boulevard within the interchange and accommodate bridge pier placement as necessary.

b. Steele Street/Vasquez and Colorado Boulevards, Interchanges and Ramp Reconstruction

i. The existing Steele Street/Vasquez and Colorado Boulevard interchanges shall be reconstructed to allow for lowering the I-70 Mainline below the roadways. Ramp connectivity to Steele Street/Vasquez and Colorado Boulevard from the I-70 Mainline shall be designed and constructed as a split diamond interchange with supplemental ramp connections on the west side of Colorado Boulevard. Specifically, ramp connectivity shall be provided for the following movements:

A. Westbound entrance ramp from Steele Street/Vasquez Boulevard;

B. Eastbound exit ramp to Steele Street/Vasquez Boulevard;

C. Westbound entrance slip ramp from Colorado Boulevard;

D. Eastbound exit slip ramp to Colorado Boulevard;

E. Westbound exit ramp to Colorado Boulevard; and

F. Eastbound entrance ramp from Colorado Boulevard.

ii. The Developer shall construct the ramps and ramp connections described above in accordance with the following criteria:

A. The Steele Street/Vasquez Boulevard westbound entrance ramp shall have a two receiving- lane terminal connection from Steele Street/Vasquez transitioning to a single lane acceleration and single lane entrance to I-70;

B. The Steele Street/Vasquez Boulevard eastbound exit ramp shall have a single-lane ramp with single-lane exit and deceleration lane. A five-lane connection that includes dual left-turn lanes, a thru lane, and a thru/right lane shall be provided to Steele/Vasquez;

C. The Steele Street/Vasquez Boulevard westbound 46th Avenue connection shall have a four-lane connection that includes dual left-turn lanes, a thru lane, and a thru/right lane provided.

D. The Steele Street/Vasquez Boulevard eastbound 46th Avenue connection shall have a two receiving-lane connection provided.

E. The Colorado Boulevard westbound entrance ramp shall have a two-lane terminal connection from Colorado Boulevard transitioning to a single lane acceleration and single lane entrance to I-70. Two receiving lanes shall also be provided at the terminal connection for 46th Avenue;

F. The Colorado Boulevard eastbound exit ramp shall have a single-lane ramp with single-lane exit and deceleration lane. A four-lane ramp terminal connection that includes a left-turn lane, a thru/left lane, a thru/right lane and a right turn lane shall be provided to Colorado Boulevard;

G. The Colorado Boulevard westbound exit ramp shall have a single-lane exit transitioning to a combined ramp/Stapleton Drive North connection to Colorado Boulevard. A five-lane connection that includes dual left-turn lanes, a thru/left lane, a thru/right lane, and a right-turn lane shall be provided to Colorado Boulevard; and

H. The Colorado Boulevard eastbound entrance ramp shall have a two-lane connection to Colorado Boulevard with a two-lane entrance and acceleration lane.

iii. Steele Street/Vasquez Boulevard shall be reconstructed to match the current existing thru lane configuration and provide left and right turn movements for the new I-70 ramps and 46th Avenue. Dual-left turns shall be provided from Steele Street/Vasquez to the westbound entrance ramp, and a single left turn provided from Steele Street/Vasquez to eastbound 46th Avenue South. Construction shall include a full movement intersection at 45th Avenue and a restricted intersection at 47th Avenue.

iv. Colorado Boulevard shall be reconstructed to match the current existing thru lane configuration and provide dual left and separate right turn movements to the I-70 ramps and new 46th Avenue. The limits of reconstruction on Colorado Boulevard shall extend from the north abutment of the existing bridge over UPRR and RTD to 48th Avenue.

v. The Developer shall include raised medians to separate the southbound and northbound lanes of Steele Street/Vasquez and Colorado Boulevard within the general limits of the roadways' reconstruction.

c. Holly Street and Interchange Ramp Construction

i. The Developer shall remove and replace the existing I-70 slip ramps located at Dahlia Street and Monaco Street with a new diamond interchange at Holly Street. The new Holly Street interchange shall be developed to allow the I-70 Mainline to pass over Holly Street. Ramp connectivity from Holly Street/Stapleton Drive to the I-70 Mainline shall be provided as eastbound exit, westbound entrance, westbound exit, and eastbound entrance ramps in accordance with the following requirements:

A. Diverging from Stapleton Drive North, the Holly Street westbound entrance ramp shall have a two-lane ramp tapering to a single-lane entrance and acceleration lane;

B. The Holly Street eastbound exit ramp shall have a single-lane ramp with single-lane exit and deceleration lane merging with Stapleton Drive South;

C. The Holly Street westbound exit ramp shall have a single-lane ramp with single-lane exit and deceleration lane merging with Stapleton Drive North; and

D. Diverging from Stapleton Drive South, the Holly Street eastbound entrance ramp shall have a two-lane ramp tapering to a single-lane entrance and acceleration lane.

ii. Reconstruction of Holly Street at the I-70 Mainline shall match the current existing number of thru lanes, but shall also include additional left turn capacity to Stapleton Drive and the ramps. Construction Work shall include, at a minimum, one thru lane each direction and dual left-turn lanes to Stapleton Drive, plus one bike lane in each direction. The extent of Construction Work on Holly Street shall be as necessary to accommodate the required lane capacity and tapers. Sidewalks shall be provided on both sides of Holly Street for the length of the new roadway construction.

d. Quebec Street and Interchange Ramp Reconstruction

i. Full reconstruction of the I-70 Mainline shall extend to the east side of the new Quebec Street Bridge. Ramp reconstruction at the Quebec Street interchange shall

consist of full reconstruction of the westbound entrance and eastbound exit ramps, and partial reconstruction, as described, of the westbound exit and eastbound entrance ramps.

ii. The Developer shall provide new I-70 ramp connections for the westbound entrance and eastbound exit ramps in accordance with the following requirements:

A. The Quebec Street westbound entrance ramp shall have a two receiving lane ramp connection with a two-lane ramp combined with an entrance lane to new westbound Stapleton Drive North. The ramp shall include a two-lane ramp entrance and two-lane acceleration to I-70; and

B. The Quebec Street eastbound exit ramp shall have a two-lane exit with two-lane deceleration and ramp. Merging of the ramp with eastbound Stapleton Drive South shall be provided in advance of a two-lane ramp terminal at Quebec Street; and

C. The Quebec Street westbound exit ramp shall have a two-lane exit with two-lane deceleration and two-lane ramp tie-in to existing. Storage length for the leftmost left-turn lane shall be extended to provide a minimum 300 total linear feet. Three hundred linear feet of right-turn auxiliary lane shall be provided to connect with the existing free right-turn lane to northbound Quebec Street; and

D. The Quebec Street eastbound entrance ramp shall be reconstructed as required to connect the existing ramp to the widened I-70 eastbound segment.

iii. Reconstruction/modification of Quebec Street below the I-70 Mainline shall match, at a minimum, the current existing number of through lanes and left-turn lane capacity to the ramps. The I-70 Mainline bridge over Quebec Street shall be constructed to the Ultimate configuration. The extent of reconstruction work on Quebec Street shall be as necessary to accommodate the required lane capacities, tapers and vertical clearances Sidewalks shall be provided on both sides of Quebec Street for the length of the new roadway construction.

e. I-270 Eastbound Connection to I-70 Mainline Reconstruction

i. The existing I-270 eastbound Bridge over I-70 Mainline shall be reconstructed to provide a structure compatible with the I-70 Ultimate configuration horizontal and vertical geometry.

ii. The I-270 connection to I-70 shall be reconstructed to the equivalent number of lanes and shoulders as currently exist. The reconstructed I-270 connection shall meet the following requirements:

A. Provide an inside shoulder. The Developer shall provide the necessary inside shoulder width to ensure an acceptable horizontal sight distance;

B. Provide two travel lanes; and

C. Provide an outside shoulder.

f. Peoria Street and Interchange Ramp Construction

i. The Developer shall provide I-70 connections to existing Peoria Street ramps and maintain the same lane and shoulder widths as the respective connecting ramp; and

ii. Peoria Street shall be reconstructed as required to accommodate new bridge piers for the replacement I-70 Mainline bridge. The Developer shall include a raised median to separate the southbound and northbound lanes of Peoria Street for the length of the new construction and to accommodate bridge pier placement as necessary. Sidewalk shall be provided on the west side of Peoria Street, and a multi-use path provided on the east side for the length of the new roadway construction.

g. Eastbound I-70 Mainline Ramp Connection to Southbound I-225 Widening

i. The existing I-70 eastbound ramp connection to I-225 southbound shall be widened to provide an additional lane. The lane shall originate from the eastbound Peoria entrance ramp as described in this Section and continue east to merge with southbound I-225.

ii. The Developer shall widen and provide a ramp connection to southbound I-225 in accordance with the following requirements:

A. Provide an inside shoulder;

B. Provide three travel lanes; and

C. Provide an outside shoulder.

iii. The Developer shall provide an appropriate ramp merge with the existing southbound I-225 lanes. The merge shall be completed in advance of the existing westbound to southbound flyover merge.

iv. Unless otherwise Approved by the Department, all entrance ramps shall be parallel type ramps as defined in the AASHTO, A Policy on Geometric Design on Highways and Streets (PGDH).

9.4.3 I-70 Cross Streets

a. UPRR Crossing

The Developer shall reconstruct the I-70 Mainline to pass beneath new UPRR 36th Yard and Service Road bridges. Trackwork required for the bridge reconstruction will be provided by UPRR Forces as described in Schedule 10, Section 10 Railroads.

b. Cross Streets at I-70 Mainline: York Street to Monroe Street

The Developer shall provide cross street connections over the I-70 Mainline and/or to 46th Avenue including necessary structures, for the following streets:

i. York Street

A. Reconstruction of the street shall provide two lanes southbound and one lane northbound from 46th Avenue to 47th Avenue, and three southbound thru lanes from 45th Avenue to 46th Avenue;

B. Construction of a new bridge over the I-70 Mainline shall include provision to accommodate future conversion of York Street to two-way with a minimum section of two thru lanes and one left turn lane in each direction. The striping layout for the Project shall provide for two thru lanes southbound and a left turn lane with the additional width of the bridge and reconstructed roadway, for the future two-way section, striped or delineated for non-use. Sidewalk shall be provided on both sides of York Street for the length of the new construction; and

C. Design and construction of York Street shall be developed to not preclude CCD's proposed planned construction of a pedestrian railroad overpass near 47th Avenue and York Street. Information on the future overpass is can be found within Appendix B Planned Denver Projects.

ii. Josephine Street

Reconstruction of the street shall provide a new bridge over the Lowered Section accommodating three northbound one-way lanes including one left-turn, one left/thru and one thru/right lane. North and south of I-70, all Construction Work on Josephine Street shall match the existing roadway width. Sidewalks shall be provided on both sides of Josephine Street for the length of the new roadway construction.

iii. Columbine Street

The Street shall be reconstructed to provide a new bridge over the Lowered Section accommodating two-way traffic, one lane in each direction, and parking lanes as described in the Cover Landscape Schematic provided in Schedule 10B Contract Drawings. North and south of the 46th Avenue, construction shall match the existing roadway width. Sidewalks shall be provided on both sides of Columbine Street for the length of the new roadway construction.

iv. Elizabeth Street

North of the I-70 Mainline, Elizabeth Street will be vacated and incorporated into the Swansea School redevelopment. South of the I-70 Mainline, Elizabeth Street shall be connected with new 46th Avenue South with left and right turn movements provided. Sidewalk connections from Elizabeth Street to new 46th Avenue shall be provided.

v. Thompson Court

A. North of the I-70 Mainline, Thompson Court shall connect to the new 46th Avenue North providing westbound right turn and southbound left turn connections as the Cover terminus point of 46th Avenue. An alleyway connection to Thompson Court from the existing Elizabeth-Thompson alley shall be provided. The Elizabeth-Thompson alley shall be resurfaced from 47th Avenue to the new alleyway connection; and

B. South of the I-70 Mainline, Thompson Court shall be constructed to connect with the new 46th Avenue South, All left and right turns shall be provided with construction matching the existing street width. Sidewalk connections from Thompson Court to new 46th Avenue shall be provided for the length of the new Thompson Court construction.

vi. Clayton Street

Reconstruction of the street shall provide a new bridge over the Lowered Section accommodating two-way traffic, one lane in each direction, plus one bike lane in each direction. North and south of 46th Avenue new construction shall match the existing pavement width. Sidewalks shall be provided on both sides of Clayton Street for the length of the new roadway construction.

vii. Fillmore Street

Reconstruction of the street shall provide a new bridge over the Lowered Section accommodating two-way traffic, one lane in each direction with right turn pockets to 46th Avenue developed at each end of the bridge. North and south of the I-70 Mainline new construction shall match the existing pavement width. Sidewalks shall be provided on both sides of Fillmore Street for the length of the new roadway construction.

viii. Milwaukee Street

North of the I-70 Mainline, Milwaukee Street shall connect to new 46th Avenue North. Left and right turn movements shall be provided. South of the I-70 Mainline, Milwaukee Street shall connect to the new 46th Avenue South with left and right turn movements provided on all legs. Sidewalk connections from Milwaukee Street to new 46th Avenue shall be provided.

ix. Cook Street

Construction of the street shall provide a new bridge over the Lowered Section accommodating two-way traffic, one lane in each direction. From approximately 45th Avenue, Cook Street shall be extended north to connect with 46th Avenue South, cross over the I-70 Mainline, and connect to 46th Avenue North with an access provided for future land use on the north side. Sidewalks shall be provided on both sides of Cook Street for the length of the new roadway construction.

x. Madison Street

South of the I-70 Mainline, Madison Street shall connect to new 46th Avenue South. Sidewalk connections from Madison Street to new 46th Avenue shall be provided.

xi. Monroe Street

Reconstruction of the street shall provide a new bridge over the Lowered Section accommodating two-way traffic, one lane in each direction. From approximately 45th Avenue, Monroe Street shall be constructed north to connect with new 46th Avenue South, cross over the I-70 Mainline, connect with new 46th Avenue North, and extend north and east to connect with existing Jackson Street. The new Monroe Street shall function as an extension of Jackson Street and serve as the primary access to those properties south of the I-70 Mainline. Sidewalks shall be provided on both sides of Monroe Street for the length of the new roadway construction.

xii. East 46th Avenue/Colorado Boulevard Connection to Jackson Street

46th Avenue along the west side of Colorado Boulevard shall be reconstructed as required for the realignment and reconstruction of Colorado Boulevard. The road shall be reconstructed to provide two-way traffic, one lane in each direction with a sidewalk along the west side. The extent of Construction Work on East 46th Avenue shall be as necessary to provide a tie-in on the north end and a connection to Jackson Street from the south end.

c. Cross Streets at I-70 Mainline: Dahlia Street to Peoria Street

The Developer shall provide Cross Street connections under the I-70 Mainline and/or to Stapleton Drive, including necessary structures, for the following streets:

i. Dahlia Street

Reconstruction of the street shall be sufficient to provide one through lane in each direction with single left-turn lanes to Stapleton Drive, under the I-70 Mainline. Sidewalks shall be provided on both sides of Dahlia Street for the length of the new roadway construction.

ii. Monaco Street

Reconstruction of the street shall be sufficient to provide one through lane northbound with dual left-turn lanes to Stapleton Drive. Southbound shall provide one left-turn, one left/thru lane, and one thru lane. Sidewalks shall be provided on both sides of the Dahlia Street for the length of the new roadway construction.

iii. Forest Street

North of the I-70 Mainline, Forest Street shall connect to new Stapleton Drive North. Right-in and right-out turn movements shall be provided. South of I-70, Forest Street shall connect to new Stapleton Drive South. Right-in and right-out turn movements shall be provided.

iv. Glencoe Street

North of the I-70 Mainline, Glencoe Street shall connect to new Stapleton Drive North. Right-in and right-out turn movements shall be provided. South of the I-70 Mainline, Glencoe Street shall connect to new Stapleton Drive South. Right-in and right-out turn movements shall be provided.

v. Grape Street

North of the I-70 Mainline, Grape Street shall connect to new Stapleton Drive North. Right-in and right-out turn movements shall be provided. South of the I-70 Mainline, Grape Street shall connect to new Stapleton Drive South. Right-in and right-out turn movements shall be provided.

vi. Ivy Street

North of the I-70 Mainline, Ivy Street shall connect to new Stapleton Drive North. Right-in and right-out turn movements shall be provided.

vii. Kearney Street

South of the I-70 Mainline, Kearney Street shall connect to new Stapleton Drive South. Right-in and right-out turn movements shall be provided.

viii. Leyden Street

North of the I-70 Mainline, Leyden Street shall connect to new Stapleton Drive North. Right-in and right-out turn movements shall be provided.

ix. Oneida Street

South of the I-70 Mainline, Oneida Street shall connect to new Stapleton Drive South. Right-in and right-out turn movements shall be provided.

x. Airlawn Road

South of the I-70 Mainline, Airlawn Road shall connect to new Stapleton Drive South. Right-in and right-out turn movements shall be provided.

xi. At each intersection, curb returns shall be constructed to meet the design vehicle requirements listed in Appendix A Roadway Design Criteria. The Developer shall provide sidewalk connections from new construction to all existing adjacent cross street sidewalks.

xii. Extents of Construction Work on all cross streets and connection streets shall be as necessary to accommodate the required lane capacity, tapers and tie-ins.

9.4.4 46th Avenue and Stapleton Drive

a. 46th Avenue North and 46th Avenue South: Brighton Boulevard to Colorado Boulevard

i. 46th Avenue shall be reconstructed as a collector street to provide east-west connectivity from Brighton Boulevard to Colorado Boulevard, and local access to adjacent neighborhoods;

ii. The Developer shall construct 46th Avenue in accordance with the following street network connectivity requirements:

A. Brighton Boulevard to York Street

(I) Provide two lane one-way operations westbound from York Street. 46th Avenue merges and is combined with the westbound exit ramp to Brighton Boulevard. CCD minimum lane width criteria may be applied to work within the Project ROW limits. Provided a continuous sidewalk along the outside of 46th Avenue North from York Street to Brighton Boulevard including a minimum 10 foot wide sidewalk under the UPRR bridge. Sidewalk width applications described in this Section shall apply for all sidewalk outside of the UPRR bridge.

(II) Provide two lane one-way operations eastbound for 46th Avenue North from the divergence point with the eastbound Brighton Boulevard entrance ramp. CCD minimum lane width criteria may be applied to minimize the span length of the proposed UPRR bridge over 46th Avenue. The eastbound approach to York Street shall include one left/thru lane, one thru lane and one right-turn lane. Provide a continuous 10 foot wide sidewalk on the outside of 46th Avenue South from Brighton Boulevard to York Street including a minimum 10 foot wide

sidewalk under the UPRR bridge. Sidewalk width applications described in this Section shall apply for all sidewalk outside of the UPRR bridge.

B. York Street to Columbine Street

(I) Along the north side, 46th Avenue North shall be two lanes one-way westbound from York Street to Josephine Street. Between Josephine Street and Columbine Street, 46th Avenue shall be one lane each direction (two-way operations). A minimum four foot curbed inside buffer shall be provided between the edge of curb and the barrier.

(II) Along the south side, 46th Avenue South shall be two lanes one-way eastbound from York Street to Josephine Street. Between Josephine Street and Columbine Street, 46th Avenue shall be one lane each direction (two-way operations). A minimum four foot curbed inside buffer shall be provided between the edge of curb and the barrier. The Developer shall provide a continuous sidewalk on the north and south sides of 46th Avenue for the length of the new roadway construction.

C. Columbine Street to Clayton Street

(I) Along the north side, 46th Avenue shall be discontinuous between Columbine Street and Thompson Court. A two-lane, two-way connection with attached sidewalk shall be provided between Thompson Court and Clayton Street. An alleyway connection shall be provided from Thompson Court to the existing Elizabeth-Thompson alley; and

(II) On the south side, 46th Avenue shall include one lane each direction (two-way operations) with a left turn lane pockets for Columbine, Elizabeth and Thompson Court access from westbound 46th Avenue. The Developer shall integrate 46th Avenue South with the design of the cover as necessary to work within ROW constraints and meet the requirements of the Cover Landscape Schematic provided in Schedule 10B Contract Drawings. This includes aesthetics, parking lanes, sidewalks, landscaping and other considerations as required.

D. Clayton Street to Milwaukee Street

(I) Provide one lane each direction (two-way operations) on 46th Avenue North with a left turn lane to Fillmore Street from westbound and eastbound 46th Avenue. Provide a minimum four foot curbed inside buffer between the edge of curb and the barrier.

(II) On 46th Avenue South, provide one lane each direction (two-way operations) with a left turn lane to Fillmore Street from eastbound and westbound 46th Avenue. Provide a minimum four foot curbed inside buffer provided between the edge of curb and the barrier. The Developer shall provide a continuous sidewalk on the south side 46th Avenue South and north side of 46th Avenue North for the length of the new roadway construction.

E. Milwaukee Street to Steele Street/Vasquez Boulevard

The Developer shall provide one lane one-way connections westbound on 46th Avenue North and eastbound on 46th Avenue South to and from merge points with the Steele/Vasquez ramps. Provide a minimum four foot curbed inside buffer between the edge of curb and the barrier. Sidewalks shall be provided on the south side 46th Avenue South and north side of 46th Avenue North to connect with the sidewalks along Steele Street/Vasquez Boulevard.

F. Steele Street/Vasquez Boulevard to Colorado Boulevard

In this segment, 46th Avenue North and South are split diamond interchange connecting roadways designed as one-way streets. On 46th Avenue North, provide two westbound lanes with a minimum four foot shoulder to the barrier. On 46th Avenue South, provide two eastbound lanes with a minimum four foot shoulder to the barrier. The Developer shall provide a continuous sidewalk on the south side 46th Avenue South and north side of 46th Avenue North for the length of the new roadway construction.

iii. Alleyway connections shall be provided at all existing alleys that currently intersect 46th Avenue.

b. Stapleton Drive North and Stapleton Drive South: Colorado Boulevard to Quebec Street

i. Stapleton Drive North and South shall be reconstructed as one-way collector street to provide east-west connectivity from Colorado Boulevard to Quebec Street, and local access to adjacent neighborhoods and commercial districts.

ii. The Developer shall design and construct Stapleton Drive in accordance with the following street network connectivity requirements:

A. Colorado Boulevard to Dahlia Street

Provide a minimum one lane eastbound on Stapleton Drive South diverging from the Colorado Boulevard entrance ramp and extending east to Dahlia Street. Provide two lanes westbound on Stapleton Drive North from Dahlia Street to merge with the Colorado Boulevard exit ramp and intersect with Colorado Boulevard. The Developer shall also provide a one-lane westbound local access road from Dahlia Street to connect to the existing East 46th Avenue near the Colorado Boulevard interchange;

B. Dahlia Street to Monaco Street

Provide two lanes eastbound on Stapleton Drive South from Dahlia Street to the merge with the Holly Street exit ramp. Provide three-lanes connecting to Holly Street, and three lanes extending east from Holly Street. Provide a minimum one lane eastbound from the Holly Street entrance ramp divergence point with a transition to a two-lane approach and connection to Monaco Street. On Stapleton Drive North, provide two lanes westbound from Monaco Street to the merge point with the Holly Street exit ramp. Provide a minimum three lanes to intersect with Holly Street, and two lanes westbound to the divergence point with the Holly Street entrance ramp. Provide a minimum one lane from the divergence point west, with a transition to a two-lane approach and connection to Dahlia Street; and

C. Monaco Street to Quebec Street

Provide two lanes minimum eastbound on Stapleton Drive South from Holly Street to Oneida Street. Provide a minimum one lane eastbound to the merge point with the Quebec Street eastbound exist ramp. On Stapleton Drive North, provide a minimum one lane westbound from the divergence point with the Quebec Street westbound entrance ramp to the first commercial property. Provide two lanes westbound to the intersection with Monaco Street.

9.4.5 Sidewalk Width Applications

a. Unless otherwise directed in this Section, sidewalks along all CDOT Roadways and Local Agency Roadways shall be provided by the Developer in accordance with CCD sidewalk and streetscape requirements applied as follows:

i. Provide a five foot detached sidewalk with 8-foot detachment width; or

ii. If prohibited by ROW constraints, provide a five foot detached sidewalk with a detachment width not less than four feet; or

iii. If prohibited by ROW constraints, provide an eight foot attached sidewalk; or

iv. If prohibited by ROW constraints, provide a five foot to eight foot minimum sidewalk.

b. Available area for sidewalk and detachment areas shall be measured from back of curb to six inches inside the roadway ROW.

c. Sidewalks, in widths of not less than five feet, shall be provided along reconstructed cross street tie-ins to match existing widths and detachment areas to match existing. Cross streets without existing sidewalk shall have sidewalk provided for the length of the reconstructed area in accordance with the standards described above.

9.4.6 CDOT Roadways, Local Agency Roadways and Intersections

a. Major street intersections: Brighton Boulevard to Quebec Street

i. Major street intersections with new 46th Avenue and/or I-70 ramps, identified as Brighton Boulevard, York Street, Steele Street/Vasquez Boulevard, Colorado Boulevard, Dahlia Street, Holly Street, Monaco Street, and the combined Stapleton Drive/Quebec Street ramps require site specific designs. The Developer shall incorporate the following design elements into the respective intersections as described:

A. Brighton Boulevard

Signal-controlled right-turn movements shall be provided at the Brighton Boulevard intersections with 46th Avenue North and the ramps. The existing eastbound exit ramp to southbound Brighton Boulevard right-turn movement shall remain in its current free-flow configuration. A dual right-turn, with a yield-controlled rightmost lane, shall be provided on northbound Brighton Boulevard to the eastbound entrance ramp and 46th Avenue South. The leftmost lane of the dual right-turn shall be signal controlled. Ramp terminals on the west side shall be aligned with the 46th Avenue/ramp terminals on the east side to provide for minimum two-lane thru traffic movements across the intersection. Dual left-turns shall be provided from the exit ramps to Brighton Boulevard;

B. York Street

A lane-drop and yield controlled right-turn shall be provided for eastbound 46th Avenue to southbound York Street;

C. Steele Street/Vasquez Boulevard

A dual right-turn movement shall be provided at the southbound Steele Street/Vasquez to westbound 46th Avenue/I-70 ramp. Free-flow right-turns shall be provided at all Steele Street/Vasquez intersections with 46th Avenue and the I-70 ramps including the rightmost lane of the dual right-turn listed above. The leftmost lane of the dual right-turn shall be signal controlled. 46th Avenue/ramp terminals on the west side shall be aligned with the ramp terminals on the east side to provide for minimum two-lane thru traffic movements across the intersection. Dual left-turns shall be provided from the exit ramps/46th Avenue to Steele Street/Vasquez Boulevard;

D. Colorado Boulevard

Dual right-turns shall be provided at eastbound 46th Avenue/I-70 ramp to southbound Colorado Boulevard; the southbound Colorado Boulevard to westbound 46th Avenue/I-70 ramp; and the westbound Stapleton Drive/I-70 ramp to northbound Colorado Boulevard. Free-flow right-turn movements shall be provided at all Colorado Boulevard intersections with 46th Avenue/Stapleton Drive and the I-70 ramps including the rightmost lanes of dual right-turns. The leftmost lanes of the dual right-turns shall be signal controlled. Both lanes of

the dual right-turn from southbound Colorado Boulevard to westbound 46th Avenue/I-70 ramp shall be exclusive right turns. The 46th Avenue/ramp terminals on the west side shall be aligned with the Stapleton Drive/ramp terminals on the east side to provide for minimum two-lane thru traffic movements across the intersection. A left-turn and left/thru lane shall be provided from the eastbound exit ramp/46th Avenue to northbound Colorado Boulevard. A dual left-turn and left/thru lane shall be provided from the westbound exit ramp/Stapleton Drive North to southbound Colorado Boulevard;

E. Dahlia and Monaco Streets

Shared right-turn lanes may be provided for right turns at Dahlia Street and Monaco Street to minimize adjacent property impacts;

F. Holly Street

Dedicated right-turn lanes shall be provided from northbound and southbound Holly Street to Stapleton Drive, and from eastbound and westbound Stapleton Drive to Holly Street. A minimum of 110 linear feet of left-turn storage shall be provided northbound and southbound approaching Stapleton Drive; and

G. Quebec Street

Yield-controlled right-turn movements shall be provided at the Quebec Street intersections with new west ramps and Stapleton Drive. The ramp terminals on the west side shall be aligned with the existing ramp terminals on the east side to provide for minimum one-lane through traffic movements across the intersections. A dual left-turn shall be provided from the eastbound exit ramps to northbound Quebec Street.

ii. When islands are required, they shall be sized to efficiently channelize traffic, provide pedestrian ramps and refuge, provide for traffic signal poles, safely cross pedestrians at auto lanes, and allow for urban amenity treatments.

iii. Alleyway connections shall be provided at all existing alleys that currently intersect 46th Avenue.

9.4.7 Coordination with Recent I-70 Reconstruction Projects

a. I-70 over Havana Street Design-Build Project (2015):

i. The Department has awarded the Havana Street Design-Build Project, I-70 over Havana Street, for design and construction. The construction work under the Havana Street Design-Build Project includes a new bridge over Havana Street, a new I-70 bridge over the future relocated UPRR spur track, earthwork, guardrail and pavement approaches to the bridges at each end. All elements of the Havana Street Design-Build will be constructed independently of the Project. With the exception of temporary pavements, guardrail, striping, etc., construction work performed under the Havana Street Design-Build Project will be compatible with the Ultimate configuration; and

ii. The Developer shall make any required modifications to these completed improvements to accommodate the integration and completion of the Construction Work. This will likely include striping, signing, barrier/guardrail transitions, embankment transitions and any other incidental/miscellaneous work required; and

iii. See Schedule 29 Reference Documents for the Havana Street Design Build Project plans.

b. I-70 over Sand Creek Bridge Replacement (2011):

i. The Department replaced the I-70 structure over Sand Creek in 2011. While significant alterations are expected necessary for the Ultimate configuration, minor or no alterations are expected to the bridge as part of the Project.

ii. See the Reference Documents for Sand Creek Bridge As-Built plan information.

9.4.8 Local Agency Roadway Infrastructure and ADA

a. Local Agency Roadways

i. The Construction Work includes the design and construction, reconstruction and closure of Local Agency Roadways. The intended configuration of these arterial, collector, and local roadways is depicted as a guide in the Reference Design drawings, conveying the general intent of the Construction Work. Local Agency Roadway improvements are defined as follows:

A. Local Agency Roadway Limits

The limits of Local Agency Roadway improvements shown in the Reference Design drawings are approximate only and shall be extended as necessary for completion of the Construction Work, including but not limited for the need to provide smooth horizontal/vertical transitions, meet ADA requirements, and other miscellaneous improvements;

B. Geometric Roadway Alignments

The horizontal and vertical alignments for the Local Agency Roadways may be changed unless otherwise prohibited by the Project Agreement. However, implementation of any proposed change must be achievable within the ROW;

C. Number of Lanes

The minimum number of lanes shall be the number depicted in the Roadway Typical Sections as shown in Schedule 10B Contract Drawings;

D. Intersections

The intersection configurations for the Local Agency Roadways depicted in the Reference Design drawings may be changed unless otherwise prohibited by the Project Agreement. The Developer may propose and submit modifications to the number of turn lanes and lane storage lengths during design development for approval by the Local Agency. The proposed modifications shall comply with the Project's traffic operational performance requirements that include reasonable expectations for travel times, safety, mobility, and User satisfaction;

E. Pedestrian Movement Design

The Developer shall be responsible for the design of pedestrian movements, including crossing locations, ramps and signals along Local Agency Roadways and the Department's Project infrastructure. It is desired to optimize pedestrian crossing movements at intersections while not significantly degrading vehicle operations. Pedestrian movements design shall consider locations of curb ramps to provide optimal sight distance and shortest route as well as requirement for all crossings at signalized intersections to be protected wherever possible. It is the desire of the Local Agency to avoid the use of directional islands and free right turn vehicle movements where possible to achieve an acceptable intersection level of service;

F. Bus Stop Locations

Bus stops to be located along 46th Avenue and other Local Agency Roadways shall be at the direction of and in coordination with the Regional Transportation District (RTD) and CCD. The Developer shall work with RTD and CCD to

provide bus stops as directed. RTD's design standards shall be used for the design of all bus stops that will be part of the Construction Work. RTD will provide materials, including benches, signage and shelters to the Developer for all bus stops within the Site at no cost to the Project; and

G. The Developer shall deliver any existing RTD bus stop amenities (benches, shelters, etc.) removed during the course of the Construction Work to RTD as directed by RTD. If agreed with RTD, the Developer may reuse existing amenities at new locations in the Work or dispose of the existing bus stop amenities.

9.4.9 Americans with Disabilities Act

The Developer shall produce ADA compliant design for Acceptance by the Department as part of the design plans. The Developer shall include a letter with each Release for Construction submittal demonstrating that the Project complies with all applicable ADA requirements.

a. Where curb ramps are to be removed and reconstructed, the Developer shall provide and maintain an alternate ADA-compliant pedestrian access route at all times; and

b. Additional ADA requirements are as follows:

i. Within the limits of the Construction Work, the Developer shall reconstruct all pedestrian facilities including curb ramps, sidewalks, and driveways to meet ADA requirements; and

ii. Any Construction Work that disturbs any portion of an intersection shall require the entire intersection be reconstructed as necessary to meet ADA requirements, regardless if this involves work outside of the Site. In locations outside of the Site only, the Developer may evaluate existing conditions and provide documentation for Acceptance that the existing infrastructure is ADA compliant.

9.4.10 Cross Slope and Superelevation

a. Normal Cross Slope

i. All new and reconstructed pavement sections shall have a normal cross slope of two percent;

ii. For pavement widening sections, the widened section shall have a normal cross slope of two percent; and

iii. For overlay sections where the existing cross slope is equal or greater than two percent, the Developer shall maintain the existing pavement cross slope. For overlay sections where the existing cross slope is less than two percent, the cross slope shall be built up through the use of a variable thickness overlay to a minimum of two percent.

b. Superelevation Rates

Superelevation runout and runoff lengths for I-70, I-270, and interchange ramps shall be designed to comply with the design criteria and methodology of the AASHTO PGDH and as described in Appendix A Roadway Design Criteria. Adjustments to superelevation transition rates and locations necessary to ensure adequate surface drainage will require Acceptance by the Department as part of the plan submittals defined in Schedule 9 Deliverables.

9.4.11 Stopping Sight Distance

Stopping sight distances and decision sight distances shall meet the minimum requirements of Appendix A Roadway Design Criteria. Stopping sight distances shall be determined in accordance with AASHTO PGDH.

9.4.12 Fill and Cut Slopes and Clear Zones

(Note: All slopes stated herein are in terms of horizontal:vertical)

a. The Developer shall design cut and fill slopes to obtain roadside clear zones in accordance with the AASHTO *Roadside Design Guide,* and avoid the need for guardrail wherever possible. Where clear zones cannot be obtained within the ROW, guardrail shall be required.

b. The Developer shall provide a maximum 3:1 traversable surface for slope maintenance and vehicle access on all vegetated slopes where flatter slopes are not achievable. The minimum slope on fill and cut slopes shall be 6:1.

c. Roadside slopes shall be designed and constructed to meet the following requirements as defined in Appendix A Roadway Design Criteria.

d. Roadside Slopes Adjacent to Pavement

i. The Point of Slope Selection (POSS) is defined as the location at which the roadside slope adjacent to the pavement, known as the Z-slope ends, and the cut, or fill slope begins. Width and slope of the area between the edge of pavement (or sidewalk) and the POSS shall be as follows:

A. I-70: 18 feet minimum at a 6:1 slope; and

B. Ramps: 12 feet at a 6:1 slope.

e. Fill Slopes

i. Fill slopes beyond the POSS shall be designed and constructed in accordance with the following priority:

A. Use 6:1 slopes where fill heights are less than four feet and can match to existing surface conditions within the ROW;

B. Use 4:1 slopes where fill heights are greater than four feet but less than 15 feet and can match to existing surface conditions within the ROW;

C. Use 3:1 slopes where fill heights are less than 15 feet, but slopes steeper than 4:1 are required to match existing surface conditions within the ROW;

D. Use 3:1 slopes where fill heights exceed 15 feet, clear zone Z-slope can be obtained, and slopes can match to existing surface conditions within the ROW;

E. Where the above requirements in this Subsection e.i. cannot be met, the Developer may use any of the following design approaches:

(I) Use 3:1 to 2.5:1 slopes with guardrail protection. Slopes steeper than 3:1 shall be limited to areas where slopes are transitioning to match slope paving at bridge abutments, or where transitioning to match existing slopes steeper than 3:1. Slopes of 2.5:1 to 3:1 shall comply with the slope stabilization requirements of Schedule 10, Section 7 Earthwork; or

(II) Use retaining walls as necessary, with guardrail protection where required.

ii. Fill slope areas shall be designed with ditches and storm sewer as necessary to prevent untreated roadside and slope drainage from flowing off the ROW to adjacent properties; and

iii. All fill slopes shall be rounded at the toes or ties to existing ground.

f. Cut Slopes

i. Cut slopes beyond the POSS shall be designed and constructed in accordance with the following priorities:

A. Cut slopes shall be transitioned at the POSS in such a manner to comply with the recommendations of the AASHTO *Roadside Design Guide*;

B. Use 4:1 or flatter slopes for cut slopes where the slope can match with existing surface conditions within the ROW;

C. Use 3:1 slopes for cut slopes where slopes steeper than 4:1 are necessary to obtain the match to existing surface conditions within the ROW;

D. Where the above conditions cannot be obtained, the Developer may use any of the following design approaches:

(I) If a full clear zone Z-slope cannot be provided, use 3:1 if the POSS is at least 10 feet from the edge of pavement; or

(II) If a full clear zone Z-slope cannot be provided, use 3:1 to 2.5:1 slopes with guardrail protection if the POSS is at less than 10 feet from the edge of pavement. Slopes steeper than 3:1 shall be limited to areas where slopes are transitioning to match slope paving at bridge abutments or where transitioning to match existing slopes steeper than 3:1.

E. Use retaining walls as necessary, with guardrail protection to match existing conditions.

ii. Cut slopes and associated ditches shall be designed as necessary to prevent untreated roadside and slope drainage from flowing off ROW to adjacent properties.

iii. All cut slopes shall be rounded at their matches to existing ground.

9.4.13 Barrier and Guardrail

a. Barrier or guardrail shall be required wherever clear zone requirements cannot be achieved;

b. Median barrier is required along the entire length of the I-70 Mainline reconstruction and widening areas. Median barrier shall be Type 7 concrete barrier with a concrete glare screen in accordance with CDOT Standard M-606-13;

c. The Developer shall replace existing median barriers within ETC and ITS infrastructure locations outside I-70 Mainline reconstruction. Existing concrete median barrier to be replaced shall include, but may not be limited to, the following locations:

i. From the western limit of I-70 Mainline reconstruction at Brighton Boulevard to approximately 2,400 feet west of the Washington Street bridge. The new barrier shall be designed and built to accommodate the existing drainage inlets; and

ii. From the eastern construction limit of I-70 Mainline widening at I-225 to approximately 2,800 feet east.

d. Guardrail along the outside shoulders of the I-70 Mainline shall be concrete barrier where inlets are required for pavement drainage. Type 3 guardrail with asphalt curb will not be permitted for drainage accommodation;

e. All concrete barrier shall be cast-in-place. Precast barrier will not be accepted for permanent installations;

f. Provide crash attenuators and rail end treatments at all required locations where barrier/guardrail begins or ends in accordance with the *CDOT Safety Guide*, Standards M-606-1 and M-606-13 and Chapter 8 of the AASHTO *Roadside Design Guide*; and

g. Concrete barrier with fence, in accordance with CDOT Bridge Standard B-607-5, shall be provided between 46th Avenue and the Lowered Section where noise walls or the Cover are not provided. At locations of proposed noise walls incorporate barrier requirements as

part of the wall design. Fencing shall conform to Schedule 10, Section 14 Landscaping and Aesthetics.

9.4.14 Driveways and Access Design

a. All private property parcels require access to public ROW. The Developer shall construct connecting roads, driveways and curb cuts to provide access to private property, or connect streets with alleyways where existing access is disturbed or reconfigured and requires relocation. Access design and location shall conform to the following requirements, in the order of precedence listed:

i. Access locations and restrictions delineated in the ROW Exhibits in Schedule 10B Contract Drawings;

ii. State of Colorado, State Highway Access Code; and

iii. CCD Permit Requirements and Municipal Codes.

b. Private property accesses from roadway ROW shall be designed and constructed using curb cuts. All public roadway connections shall be designed with curb returns. Private accesses to properties shall be reconstructed in their current locations unless otherwise agreed to by the property owner and the Department; and

c. Connecting roads and driveways shall be paved to the ROW limits in accordance with pavement requirements defined by the Local Agency. Connecting roads and driveways shall be replaced in kind as required beyond the ROW line to the limits necessary to match existing grade. Curb return openings that are provided for future connections shall be paved through the curb returns.

9.4.15 Design Exceptions

a. Identified Design Exceptions

Table 9-1 lists design exceptions that have been identified by the Department and will be required for the Construction Work. Approval of these exceptions will be obtained by the Department from FHWA prior to NTP 1. Approval of additional or revised design exceptions required for the Developer's design shall be obtained by the Department in accordance with the requirements below.

b. Design Exception Process

The Developer shall comply with the following requirements when requesting a design exception:

i. The Developer shall submit five copies of design exception requests in the form of a letter addressed to the Department; and

ii. The design exception request submittals shall consist of the following items:

A. A letter identifying the exception(s) by number, Project number, location, and status (new submittal, resubmittal, etc.);

B. A completed CDOT Form 464a;

C. Supporting documentation indicating the justification for the exception. Justification shall address the following items:

(I) Site conditions of the exception;

(II) Compelling reason for the exception, including which standard is not being met, if the exception affects any other standards, and what will be done to mitigate the effects of the exception;

(III) Effects of the exception on safety and operation of the facility;

(IV) Previous crash history near the location of the exception;

(V) Calculations estimating the cost of attaining the design standard and costs of exception as proposed; and

(VI) Effect on scenic, historical, or other environmental features.

D. Plan and profile drawings depicting the exception.

c. Possible Additional Design Exceptions

The Reference Design acknowledges conflicts that exist within the design as shown, that without alterations, require additional design exceptions be requested by the Developer. It shall be the Developer's responsibility to evaluate the Reference Design as shown, identify design conflicts, and make appropriate alterations to the design, or request design exceptions in accordance with the procedures listed above.

i. The following design conflicts are acknowledged within the Reference Design:

A. Stopping sight distance on the eastbound I-70 auxiliary lane at Dahlia Street

The design speed of I-70 (70 mph) requires a substantial additional shoulder width along inside of curve where guardrail is proposed.

B. Stopping sight distance on the westbound I-70 Tolled Express Lane at Dahlia Street

The design speed of I-70 (70 mph) requires substantial additional shoulder width along inside of curve where median guardrail is proposed.

C. Outside shoulder width on the eastbound I-70 on the Sand Creek bridge

Available width for outside shoulder does not meet minimum shoulder width requirements.

Table 9-1 Identified Design Exceptions

No.	Item	Design Criteria	Design Exception	Comments
DE-1	Inside shoulder width on I-70 between I-25 and Brighton Boulevard	12 ft.	4 ft.	Exception required to stripe Tolled Express Lane within existing wide shoulder.
DE-2	Inside shoulder width on I-70 at pier and structure locations	12 ft.	10 ft.	Exception required for reduced shoulder width at bridge piers and overhead sign structures.
DE-3	Inside shoulder width on I-70, east of Quebec Street	12 ft.	4 ft.	Exception required to fit a tolled express lane on the inside of an existing highway section with minimal widening.

9.5 Construction Requirements

9.5.1 Removals

The Developer shall be responsible for the removal of all items within the Site not incorporated into the Construction Work. Removal items shall become the property of the Developer unless identified during the design review to remain property of the Department, CCD, or other agency. Removal items shall include, but not be limited to structures/portions of structures and obstructions, retaining walls, signs designated for removal, pavements, curbs, excavation, guardrail, fencing, landscaping, and pavement markings.

a. Roadways

The Developer shall remove abandoned portions of roadways and roadway fills reconstructed as a part of the Construction Work. The Developer shall smooth the area to blend into adjacent terrain, and topsoil and seed.

b. Buried Foundations

Buried foundations from abandoned structures are believed to exist within the Project Site. Specifically, the buried foundations from the original Swansea Elementary School and pedestrian underpass located near 46th Avenue and Columbine Street. The Developer shall remove and backfill as necessary all buried foundations found to be in conflict with the Construction Work.

9.5.2 Guardrail

The Developer shall use galvanized guardrail (CDOT Standard Plan No. M606-1) with steel posts and composite block for guardrail installations which are not required to be concrete, unless otherwise Approved by the Department. The Developer shall pave asphalt a minimum of one foot behind the new guardrail in accordance with the CDOT *M & S Standard Plans*.

9.5.3 Fencing

a. Temporary Fencing

The Developer shall provide temporary fencing as required by property acquisition agreements to protect adjacent private property. In remaining areas, temporary fencing should be considered to control construction operations beyond ROW and construction limits. Temporary fence shall also be placed to protect sensitive environmental resources, as required by Schedule 17 Environmental Requirements.

b. Permanent Fencing

The Developer shall provide permanent fencing of types at the following locations. Permanent fencing shall be compatible with Schedule 10, Section 14 Landscaping and Aesthetics.

i. South side ROW line from Brighton Boulevard to York Street (along Purina property);

ii. North side ROW line from DRIRR to Quebec Street (along DRIRR property);

iii. South side ROW line from DRIRR to Quebec Street; and

iv. Water quality/detention ponds (where required).

c. Gates

The Developer shall provide gates in fences at locations and of width and type as specified by the Department or maintaining entities for maintenance access.

9.6 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the specified timeframes:

Table 9-2 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Design exceptions	Approval	Prior to RFC Documents

9.7 Appendices

Appendix A Roadway Design Criteria

Appendix B Denver Planned Projects

Appendix A
Roadway Design Criteria

I-70 Mainline				
Design Element	**I-25 to Colorado Boulevard (Project)**	**Quebec Street to Chambers Road (Project)**	**Colorado Boulevard to Tower Road (Project and Ultimate)**	**Remarks**
Standards Applied	CDOT/FHWA			
General				
Roadway Classification	Interstate	Interstate	Interstate	
Posted Speed (MPH)	55	55	-	
Design Speed (MPH)	60	65	70	
Design Vehicle	WB-67	WB-67	WB-67	
Horizontal Alignment Criteria				
Curve Radius (Feet) - Minimum	1,330	1,660	2,040	
Stopping Sight Distance (Feet) - At level grade	570	645	730	
Cross Slope	2%	2%	2%	
Superelevation (e_{max})	6%	6%	6%	
Clear Zone on Tangent (Feet)				
Minimum	30	30	30	Apply curve factors, as required, Per RDG
Desirable	34	34	34	
Lane Widths (Feet)	12	12	12	
Shoulder Widths (Feet)				
Inside	12	12	12	
Outside	12	12	12	
Auxiliary Lanes				
Minimum	6	6	6	Allowable only within ROW constraints
Desirable	12	12	12	
Side Slopes				
Cut Slope	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	
Fill Slope	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	

I-70 Mainline				
Design Element	**I-25 to Colorado Boulevard (Project)**	**Quebec Street to Chambers Road (Project)**	**Colorado Boulevard to Tower Road (Project and Ultimate)**	**Remarks**
Z-slope Dist (6:1 Slope) (Feet)	-	12	12	
Vertical Alignment Criteria				
K-Values				
Crest Vertical Curve	151	193	247	
Sag Vertical Curve	136	157	181	
Grade				
Maximum	4%	3%	3%	
Minimum	0.75%	0.5%	0.5%	
Vertical Clearance at Structures (Feet) - Minimum				
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	
Cover Over Highway/Street	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	
Tolled Express Lanes (Feet)				
Buffer Width	4	4	4	
Ingress/Egress Lengths	2,000	2,000	2,000	
Weave Distance per Lane at all Ingress/Egress Locations	800	800	800	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Brighton Boulevard Ramps

Design Element	Brighton Boulevard Westbound Entrance Ramp	Brighton Boulevard Eastbound Exit Ramp	Brighton Boulevard Westbound Exit Ramp	Brighton Boulevard Eastbound Entrance Ramp	Remarks
Standards Applied	CDOT/FHWA				
General					
Roadway Classification	Ramp	Ramp	Ramp	Ramp	
Design Speed (MPH) (Ramp Proper)	45	45	45	35	
Design Vehicle	WB-67	WB-67	WB-67	WB-67	
EN-EX Ramp Spacing on Mainline (Weave)	1,000	950	1,600	1,600	
Horizontal Alignment Criteria					
Curve Radius (Feet) - Minimum					
Design Speed (Ramp Proper)	643	643	643	340	
Stopping Sight Distance at Design Speed (Feet) - At level grade					
Design Speed (Ramp Proper)	360	360	360	250	
Cross Slope	2%	2%	2%	2%	
Superelevation (e max)	6%	6%	6%	6%	
Clear Zone (Feet)					
Minimum	20	20	20	20	
Desirable	22	22	22	22	
Number of Lanes	1	2	1	2	
Lane Widths (Feet)	15	12+12	15	12+12	
Shoulder Widths (Feet)					
Inside	4	4	4	4	
Outside	6	8	6	8	
Side Slopes					
Cut Slope	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	
Fill Slope	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	
Z-slope Dist (6:1 Slope) (Feet)	12	12	12	12	

Brighton Boulevard Ramps					
Design Element	**Brighton Boulevard Westbound Entrance Ramp**	**Brighton Boulevard Eastbound Exit Ramp**	**Brighton Boulevard Westbound Exit Ramp**	**Brighton Boulevard Eastbound Entrance Ramp**	**Remarks**
Vertical Alignment Criteria					
K-Values					
Crest Vertical Curve					
Design Speed (Ramp Proper)	61	61	61	29	
Sag Vertical Curve					
Design Speed (Ramp Proper)	79	79	79	49	
Grade					
Maximum	5%	6%	4%	4%	
Minimum	0.5%	0.5%	0.5%	0.5%	
Vertical Clearance at Structures - Minimum					
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Vasquez Boulevard/Steele Street Ramps			
Design Element	**Vasquez Boulevard Westbound Entrance Ramp**	**Steele Street Eastbound Exit Ramp**	**Remarks**
Standards Applied	CDOT/FHWA		
General			
Roadway Classification	Ramp	Ramp	
Design Speed (MPH) (Ramp Proper)	50	45	
Design Vehicle	WB-67	WB-67	
EN-EX Ramp Spacing on Mainline (Weave)	1,600	1,600	
Horizontal Alignment Criteria			
Curve Radius (Feet) - Minimum			
Design Speed (Ramp Proper)	833	643	
Stopping Sight Distance at Design Speed (Feet) - At level grade			
Design Speed (Ramp Proper)	425	360	
Cross Slope	2%	2%	
Superelevation Method	Method 5	Method 5	
Superelevation (e max)	6%	6%	
Superelevation Transitions	80%/20%	80%/20%	
Clear Zone (Feet)			
Minimum	20	20	
Desirable	22	22	
Number of Lanes	1	1	
Lane Widths (Feet)	15	15	
Shoulder Widths (Feet)			
Inside	4	4	
Outside	6	6	
Side Slopes			
Cut Slope	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	
Fill Slope	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	
Z-slope Dist (6:1 Slope) (Feet)	12	12	
Vertical Alignment Criteria			
K-Values			

Vasquez Boulevard/Steele Street Ramps			
Design Element	**Vasquez Boulevard Westbound Entrance Ramp**	**Steele Street Eastbound Exit Ramp**	**Remarks**
Crest Vertical Curve			
Design Speed (Ramp Proper)	84	61	
Sag Vertical Curve			
Design Speed (Ramp Proper)	96	79	
Grade			
Maximum	5%	5%	
Minimum	0.5%	0.5%	
Vertical Clearance at Structures - Minimum			
Highways/Streets Over Highway/Street	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Colorado Boulevard Ramps					
Design Element	**Colorado Boulevard Westbound Entrance Slip Ramp**	**Colorado Boulevard Eastbound Exit Ramp**	**Colorado Boulevard Westbound Exit Ramp**	**Colorado Boulevard Eastbound Entrance Ramp**	**Remarks**
Standards Applied	CDOT/FHWA				
General					
Roadway Classification	Ramp	Ramp	Ramp	Ramp	
Design Speed (MPH) (Ramp Proper)	45	45	35	45	
Design Vehicle	WB-67	WB-67	WB-67	WB-67	
EN-EN and EN-EX Ramp Spacing on Mainline (Weave)	1,000	1,600	1,600	1,600	
Horizontal Alignment Criteria					
Curve Radius (Feet) - Minimum					
Design Speed (Ramp Proper)	643	643	340	643	
Stopping Sight Distance at Design Speed (Feet) - At level grade					
Design Speed (Ramp Proper)	360	360	250	360	
Cross Slope	2%	2%	2%	2%	
Superelevation (e max)	6%	6%	6%	6%	
Clear Zone (Feet)					
Minimum	20	20	20	20	
Desirable	22	22	22	22	
Lane Widths (Feet)	15	15	15	12+12	
Shoulder Widths (Feet)					
Inside	4	4	4	4	
Outside	6	6	6	8	
Side Slopes					
Cut Slope	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	
Fill Slope	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	

Colorado Boulevard Ramps					
Design Element	**Colorado Boulevard Westbound Entrance Slip Ramp**	**Colorado Boulevard Eastbound Exit Ramp**	**Colorado Boulevard Westbound Exit Ramp**	**Colorado Boulevard Eastbound Entrance Ramp**	**Remarks**
Z-slope Dist (6:1 Slope) (Feet)	12	12	12	12	
Vertical Alignment Criteria					
K-Values					
Crest Vertical Curve					
Design Speed (Ramp Proper)	61	61	29	61	
Sag Vertical Curve					
Design Speed (Ramp Proper)	79	79	49	79	
Grade					
Maximum	6%	6%	4%	4%	
Minimum	0.5%	0.5%	0.5%	0.5%	
Vertical Clearance at Structures - Minimum					
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Holly Street Ramps					
Design Element	**Holly Street Westbound Entrance Ramp**	**Holly Street Eastbound Exit Ramp**	**Holly Street Westbound Exit Ramp**	**Holly Street Eastbound Entrance Ramp**	**Remarks**
Standards Applied	CDOT/FHWA				
General					
Roadway Classification	Ramp	Ramp	Ramp	Ramp	
Design Speed (MPH) (Ramp Proper)	45	50	45	45	
Design Vehicle	WB-67	WB-67	WB-67	WB-67	
EN-EX Ramp Spacing on Mainline (Weave)	1,600	1,600	1,600	1,600	
Horizontal Alignment Criteria					
Curve Radius (Feet) - Minimum					
Design Speed (Ramp Proper)	643	833	643	643	
Stopping Sight Distance at Design Speed (Feet) - At level grade					
Design Speed (Ramp Proper)	360	425	360	360	
Cross Slope	2%	2%	2%	2%	
Superelevation (e max)	6%	6%	6%	6%	
Clear Zone (Feet)					
Minimum	20	20	20	20	
Desirable	22	22	22	22	
Number of Lanes	2	1	1	2	
Lane Widths (Feet)	12+12	15	15	12+12	
Shoulder Widths (Feet)					
Inside	4	4	4	4	
Outside	8	6	6	8	
Side Slopes					
Cut Slope	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	
Fill Slope	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	
Z-slope Dist (6:1 Slope) (Feet)	12	12	12	12	

Holly Street Ramps					
Design Element	**Holly Street Westbound Entrance Ramp**	**Holly Street Eastbound Exit Ramp**	**Holly Street Westbound Exit Ramp**	**Holly Street Eastbound Entrance Ramp**	**Remarks**
Vertical Alignment Criteria					
K-Values					
Crest Vertical Curve					
Design Speed (Ramp Proper)	61	84	61	61	
Sag Vertical Curve					
Design Speed (Ramp Proper)	79	96	79	79	
Grade					
Maximum	4%	4%	4%	4%	
Minimum	0.5%	0.5%	0.5%	0.5%	
Vertical Clearance at Structures - Minimum					
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Quebec Street Ramps					
Design Element	**Quebec Street Westbound Entrance Ramp**	**Quebec Street Eastbound Exit Ramp**	**Quebec Street Westbound Exit Ramp**	**Quebec Street Eastbound Entrance Ramp**	**Remarks**
Standards Applied	CDOT/FHWA				
General					
Roadway Classification	Ramp	Ramp	Ramp	Ramp	
Design Speed (MPH) (Ramp Proper)	50	35	35	45	
Design Vehicle	WB-67	WB-67	WB-67	WB-67	
EN-EX Ramp Spacing on Mainline (Weave)	1,600	1,600	1,600	1,600	
Horizontal Alignment Criteria					
Curve Radius (Feet) - Minimum					
Design Speed (Ramp Proper)	833	340	340	1665	
Stopping Sight Distance at Design Speed (Feet) - At level grade					
Design Speed (Ramp Proper)	425	250	250	360	
Cross Slope	2%	2%	2%	2%	
Superelevation (e max)	6%	6%	6%	6%	
Clear Zone (Feet)					
Minimum	20	20	20	20	
Desirable	22	22	22	22	
Number of Lanes	2	2	2	2	
Lane Widths (Feet)	12+12	12+12	12+12	12+12	
Shoulder Widths (Feet)					
Inside	4	4	4	4	
Outside	8	8	8	8	
Side Slopes					
Cut Slope	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	
Fill Slope	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	

Quebec Street Ramps					
Design Element	**Quebec Street Westbound Entrance Ramp**	**Quebec Street Eastbound Exit Ramp**	**Quebec Street Westbound Exit Ramp**	**Quebec Street Eastbound Entrance Ramp**	**Remarks**
Z-slope Dist (6:1 Slope) (Feet)	12	12	12	12	
Vertical Alignment Criteria					
K-Values					
Crest Vertical Curve					
Design Speed (Ramp Proper)	84	29	84	61	
Sag Vertical Curve					
Design Speed (Ramp Proper)	96	49	96	79	
Vertical Clearance at Structures - Minimum					
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

I-270 and Central Park Boulevard Ramps							
Design Element	**I-270 Southbound Connector**	**Central Park Boulevard Westbound Entrance Ramp**	**Central Park Boulevard Eastbound Exit Ramp**	**I-70 Westbound to I-270 Ramp**	**Central Park Boulevard Eastbound Entrance Ramp**	**I-270 Eastbound to I-70 Eastbound Ramp**	**Remarks**
Standards Applied	CDOT/FHWA						
General							
Roadway Classification	Ramp	Ramp	Ramp	Ramp	Ramp	Ramp	
Design Speed (MPH) (Ramp Proper)	55	55	55	55	55	55	
Design Vehicle	WB-67	WB-67	WB-67	WB-67	WB-67	WB-67	
EN-EX Ramp spacing on mainline (weave)	1,600	1,600	1,600	1,000	1,600	1,000	
Horizontal Alignment Criteria							
Curve Radius (Feet) - Minimum							
Design Speed (Ramp Proper)	1,060	1,060	1,060	1060	1,060	1,060	
Stopping Sight Distance at Design Speed (Feet) - At level grade							
Design Speed (Ramp Proper)	495	495	495	360	495	495	
Cross Slope	2%	2%	2%	2%	2%	2%	
Superelevation (e max)	6%	6%	6%	6%	6%	6%	
Clear Zone (Feet)							
Minimum	20	16	16	16	16	16	
Desirable	22	18	18	18	18	18	
Number of Lanes	2	1	1	2	1	2	
Lane Widths (Feet)	12+12	15	15	12+12	15	12+12	
Shoulder Widths (Feet)							
Inside	4	4	4	4	4	4	
Outside	8	6	8	8	6	10	
Side Slopes							
Cut Slope	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	

I-270 and Central Park Boulevard Ramps							
Design Element	**I-270 Southbound Connector**	**Central Park Boulevard Westbound Entrance Ramp**	**Central Park Boulevard Eastbound Exit Ramp**	**I-70 Westbound to I-270 Ramp**	**Central Park Boulevard Eastbound Entrance Ramp**	**I-270 Eastbound to I-70 Eastbound Ramp**	**Remarks**
Fill Slope	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	
Z-slope Dist (6:1 Slope) (Feet)	12	12	12	12	12	12	
Vertical Alignment Criteria							
K-Values							
Crest Vertical Curve							
Design Speed (Ramp Proper)	114	114	114	61	114	114	
Sag Vertical Curve							
Design Speed (Ramp Proper)	115	115	115	79	115	115	
Grade							
Maximum	4%	5%	4%	4%	4%	4%	
Minimum	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	
Vertical Clearance at Structures - Minimum							
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Peoria Street and I-25 Ramps

Design Element	Peoria Street Westbound Entrance Ramp	Peoria Street Eastbound Exit Ramp	Peoria Street Eastbound Entrance Ramp	I-70 EB to I-225 Southbound GP Connector Ramp	Remarks
Standards Applied	CDOT/FHWA				
General					
Roadway Classification	Ramp	Ramp	Ramp	Ramp	
Design Speed (MPH) (Ramp Proper)	45	45	45	55	
Design Vehicle	WB-67	WB-67	WB-67	WB-67	
EN-EX Ramp spacing on mainline (weave)	1,600	1,600	1,600	1,600	
Horizontal Alignment Criteria					
Curve Radius (Feet) - Minimum					
Design Speed (Ramp Proper)	643	643	643	1060	
Stopping Sight Distance at Design Speed (Feet) - At level grade					
Design Speed (Ramp Proper)	360	360	360	495	
Cross Slope	2%	2%	2%	2%	
Superelevation (e max)	6%	6%	6%	6%	
Clear Zone (Feet)					
Minimum	16	16	16	16	
Desirable	18	18	18	18	
Number of Lanes	2	2	2	3	
Lane Widths (Feet)	12+12	12+12	12+10	12+12+12	
Shoulder Widths (Feet)					
Inside	4	4	4	12	
Outside	8	8	6	12	
Side Slopes					
Cut Slope	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	Equal to or Flatter than 3:1	
Fill Slope	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	Equal to or Flatter than 4:1 (H<15)	
Z-slope Dist (6:1 Slope) (Feet)	12	12	12	12	

Peoria Street and I-25 Ramps					
Design Element	**Peoria Street Westbound Entrance Ramp**	**Peoria Street Eastbound Exit Ramp**	**Peoria Street Eastbound Entrance Ramp**	**I-70 EB to I-225 Southbound GP Connector Ramp**	**Remarks**
Vertical Alignment Criteria					
K-Values					
Crest Vertical Curve					
Design Speed (Ramp Proper)	61	61	61	114	
Sag Vertical Curve					
Design Speed (Ramp Proper)	79	79	79	115	
Grade					
Maximum	4%	4%	5%	4%	
Minimum	0.5%	0.5%	0.5%	0.5%	
Vertical Clearance at Structures - Minimum					
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Cross Street, Brighton Boulevard to Clayton Street						
Design Element	**Brighton Boulevard**	**York Street**	**Josephine Street**	**Columbine Street**	**Clayton Street**	**Remarks**
Standards Applied	Denver	Denver	Denver	Denver	Denver	
General						
Roadway Classification	4-lane Minor Arterial	2-lane Minor Arterial	2-lane Minor Arterial	2-lane Local	2-lane Collector	
Posted Speed Limit (MPH)	35	30	30	25	25	
Design Speed (MPH)	35	35	35	30	30	
Design Vehicle	WB-67	WB-67	WB-67	SU-30	SU-30	
Horizontal Alignment Criteria						
Curve Radius (Feet) - Minimum	340	510	510	333	333	
Stopping Sight Distance at Design Speed (Feet) - At level grade	250	250	250	200	200	
Cross Slope	2%	2%	2%	2%	2%	
Superelevation (e max)	NC	NC	NC	NC	NC	
Clear Zone (Feet)						
Minimum	N/A	N/A	N/A	N/A	N/A	
Desirable	N/A	N/A	N/A	N/A	N/A	
Lane Widths (Feet)	11	12	16 to 18	18	18	
Shoulder Widths (Feet)						
Inside	0	0	0	0	0	
Outside	0	4	4	0	0	
Vertical Alignment Criteria						
K-Values						
Crest Vertical Curve	29	29	29	19	19	
Sag Vertical Curve	49	49	49	37	37	
Grade						
Maximum	6%	6%	6%	6%	6%	
Minimum	0.7%	0.7%	0.7%	0.7%	0.7%	
Vertical Clearance at Structures - Minimum						
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	

Cross Street, Brighton Boulevard to Clayton Street						
Design Element	**Brighton Boulevard**	**York Street**	**Josephine Street**	**Columbine Street**	**Clayton Street**	**Remarks**
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Cross Street, Fillmore Street to Colorado Boulevard						
Design Element	**Fillmore Street**	**Steele Street/ Vasquez Boulevard**	**Cook Street**	**Monroe Street**	**Colorado Boulevard**	**Remarks**
Standards Applied	Denver	CDOT/FHWA	Denver	Denver	CDOT/FHWA	
General						
Roadway Classification	2-lane Local	4-lane Minor Arterial	2-lane Local	2-lane Collector	6-lane Principal Arterial	
Posted Speed Limit (MPH)	25	25	25	15	40	
Design Speed (MPH)	30	35	30	20	45	
Design Vehicle	SU-30	WB-67	SU-30	WB-67	WB-67	
Horizontal Alignment Criteria						
Curve Radius (Feet) - Minimum	333	510	333	107	1,039	
Stopping Sight Distance at Design Speed (Feet) - At level grade	200	250	200	115	360	
Cross Slope	2%	2%	2%	2%	2%	
Superelevation (e max)	NC	NC	NC	NC	NC	
Clear Zone (Feet)						
Minimum	N/A	N/A	N/A	N/A	20	
Desirable	N/A	N/A	N/A	N/A	22	
Lane Widths (Feet)	18	12	18	20	12	
Shoulder Widths (Feet)						
Inside	0	0	0	0	0	
Outside	0	4	0	0	4	
Vertical Alignment Criteria						
K-Values						
Crest Vertical Curve	19	29	19	7	61	
Sag Vertical Curve	37	49	37	17	79	
Grade						
Maximum	6%	6%	6%	6%	6%	
Minimum	0.7%	0.5%	0.7%	0.7%	0.5%	
Vertical Clearance at Structures - Minimum						
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	

Cross Street, Fillmore Street to Colorado Boulevard						
Design Element	**Fillmore Street**	**Steele Street/ Vasquez Boulevard**	**Cook Street**	**Monroe Street**	**Colorado Boulevard**	**Remarks**
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Cross Street, Dahlia Street to Peoria Street						
Design Element	**Dahlia Street**	**Holly Street**	**Monaco Street**	**Quebec Street**	**Peoria Street**	**Remarks**
Standards Applied	Denver	Denver	Denver	CDOT/FHWA	Denver	
General						
Roadway Classification	2-lane Collector	2-lane Arterial	2-lane Arterial	4-lane Principal Arterial	2-lane Arterial	
Posted Speed Limit (MPH)	35	30	30	40	35	
Design Speed (MPH)	40	35	35	45	40	
Design Vehicle	WB-67	WB-67	WB-67	WB-67	WB-67	
Horizontal Alignment Criteria						
Curve Radius (Feet) - Minimum	762	510	510	1,039	762	
Stopping Sight Distance at Design Speed (Feet) - At level grade	305	250	250	360	305	
Cross Slope	2%	2%	2%	2%	2%	
Superelevation (e max)	NC	NC	NC	NC	NC	
Clear Zone (Feet)						
Minimum	N/A	N/A	N/A	20	N/A	
Desirable	N/A	N/A	N/A	22	N/A	
Lane Widths (Feet)	11	12	12	12	12	
Shoulder Widths (Feet)						
Inside	0	0	0	0	0	
Outside	0	0	0	0	0	
Vertical Alignment Criteria						
K-Values						
Crest Vertical Curve	44	29	29	61	44	
Sag Vertical Curve	64	49	49	79	64	
Grade						
Maximum	6%	6%	6%	6%	6%	
Minimum	0.7%	0.7%	0.7%	0.5%	0.7%	
Vertical Clearance at Structures - Minimum						
Highways/Streets Over Highway/Street	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	

Cross Street, Dahlia Street to Peoria Street						
Design Element	**Dahlia Street**	**Holly Street**	**Monaco Street**	**Quebec Street**	**Peoria Street**	**Remarks**
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	20'-0"	20'-0"	20'-0"	
Overhead Wires	21'-6"	21'-6"	21'-6"	21'-6"	21'-6"	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17'-6"	17'-6"	17'-6"	17'-6"	
Bridge Structure over Sidewalk	10'-0"	10'-0"	10'-0"	10'-0"	10'-0"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Design Element	46th Avenue/ Stapleton Drive	Local Road	UPRR Sidewalk	Remarks
Standards Applied	Denver	Denver	Denver	
General				
Roadway Classification	Collector	Access	Sidewalk	
Posted Speed Limit (MPH)	35	25	N/A	
Design Speed (MPH)	35	25	N/A	
Design Vehicle	WB-67	SU-30	N/A	
Horizontal Alignment Criteria				
Curve Radius (Feet) - Minimum	510	198	N/A	
Stopping Sight Distance at Design Speed (Feet) - At level grade	250	155	N/A	
Cross Slope	2%	2%	2%	
Superelevation (e max)	NC	NC	N/A	
Number of Thru Lanes	2	2	N/A	
Lane Widths (Feet)	12	10-16	N/A	
Shoulder Widths	4	0-4	N/A	
Vertical Alignment Criteria				
K-Values				
Crest Vertical Curve	29	12	N/A	
Sag Vertical Curve	49	26	N/A	
Grade				
Maximum	6%	6%	5%	
Minimum	0.7%	0.7%	0.5%	
Maximum at railroad crossings	0.1%	0.1%	N/A	
Vertical Clearance at Structures - Minimum				
Highways/Streets Over Highway/Street	16'-6"	16.5	16.5	
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16.5	16.5	
UPRR/BNSF over Highway/Street[2]	17'-6"	17.5	17.5	
UPRR/BNSF over Highway/Street[3]	20'-0"	20.0	20.0	
Overhead Wires	21'-6"	21.5	21.5	
Pedestrian/Utilities/Sign Structures over Highway/Street	17'-6"	17.5	17.5	
Bridge Structure over Sidewalk	10'-0"	10.0	10.0	

Design Element	46th Avenue/ Stapleton Drive	Local Road	UPRR Sidewalk	Remarks

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

Appendix B
Denver Planned Projects

Funded

Martin Luther King Roadway (Havana to Peoria)
Central Park Boulevard (40th Avenue to 56th Avenue)
Brighton Blvd. 29th to 44th
EADP
TBDP
UPRR Yard and Office Improvements (around 38th Street)
38th & Blake Roadway and Sidewalk Improvements
33rd Street Outfall
35th Street Ped Bridge over Platte River
Festival (between 33rd and 35th) & 33rd Streets (between Brighton and the river)

Unfunded 2015-2020

Globeville-Elyria Swansea Rec Center Improvements
RiNO Park
Brighton Blvd 44th to Race
National Western Center Master Plan Improvements
Safety Training Facility (near 31st & the river)
Public Works Solid Waste Facility (NE Denver - location unknown)
Police District Station 5 Replacement (at current location at 46th & Peoria or elsewhere in NE Denver)
Swansea Rec Center Enhancements
Parks Maintenance Facility (Smith & Havana)
56th Avenue Reconstruction, Havana to Pena
Washington Street - 47th to 52nd Reconstruction
35th Street from Arkins to Wazee
Blake Street (38th Street to Broadway) Two-Way Conversion
Central Park Boulevard Widening (36th Avenue to I-70)
Quebec Reconstruction (35th to 53rd Place)
40th Avenue Widening (Central Park to Havana)
City Park Roadway Reconstruction
Broadway Corridor Multi-Modal Improvements (Colfax to I-25)
38th & Blake Station Signalization and Multi-Modal Improvements
21st Street/Festival Street - Blake to Lawrence
Globeville Elyria-Swansea Pedestrian Connectivity Improvements
47th & York Ped Bridge
RiNo Ped Bridge (S. Platte River)
NE Quadrant Transit Improvements
City Park Playground and Ped Circulation
Swansea Neighborhood Park Improvements (52nd & Steele)
Elyria Park Improvements

Heron Pond/Northside Park/52nd & Emerson Infrastructure
Ongoing Local Roadway Improvements and Development north of I-70 in Stapleton, from I-70 to City Limits

Havana Street from Smith Road to Florence

Westerly Creek North and Sand Creek Channel and Park Improvements (Stapleton)

Smith Road Construction From Sand Creek to Havana (Stapleton)

Central Park Boulevard (56th Avenue north to City Limits)

Urban Greenway Corridor North (River North) Trail Improvements

Unfunded 2020-2026

New Northfield (Stapleton) Fire Station at 51st & Beeler

Police District 6 Station Replacement (1566 N. Washington)

County Jail Improvements (Havana & Smith Road)

Brighton Blvd./Race Street BNSF Underpass

Brighton Blvd./York BNSF Underpass

48th & Holly Roadway Expansion

47th & York Long-Term Improvement

40th & Colorado Station Area Connectivity
Brighton Boulevard - Northern Section and RR Bridge at Race Court

38th Avenue Intersection and Pedestrian Improvements

31st Street Bike-Ped Bridge

Platte River Enhancements (Confluence Park to I-70)

Platte River Enhancements (I-70 to City Limits)

River Promenade (River North) 29th to 38th

10. RAILROADS

10.1 General

10.1.1 This Section sets out the roles and responsibilities of the Developer, the Department, and the Railroads with respect to the requirements applicable to Construction Work performed on, over, under and/or adjacent to Railroad right-of-way, including track, structures and signals required for the Project.

10.1.2 Union Pacific Railroad Grade Separation and 36th Classification Yard

a. Existing conditions have the I-70 Mainline passing over the Union Pacific Railroad (UPRR) on a viaduct built in the early 1960's, while 46th Avenue passes under the UPRR via a grade separation structure built in 1939. The proposed UPRR Crossing over the Lowered Section consists of bridge demolition, bridge construction, trackwork, Railroad and traffic signalization, Utility Relocation and signalization interconnect;

b. The UPRR RRA reflects UPRR approval of:

i. 100% temporary and permanent trackwork design and construction phasing for the proposed UPRR Crossing which the Developer shall not be permitted to amend; and

ii. 30% design for the Construction Work on UPRR right-of-way, including the bridges that carry the trackwork and service road, of which the Developer shall have the responsibility to complete, including coordination with UPRR to obtain approval of the 100% design;

c. UPRR shall be responsible to provide all Railroad flagging, trackwork, ballast, and Railroad signalization. The Developer shall be responsible for all other Elements of the UPRR Crossing, including but not limited to the bridge construction, shoring, grading, subgrade and subballast placement, and related Utility Work. It shall be the Developer's responsibility to coordinate the scheduling of all separate Railroad Forces required for the performance of all Construction Work related to the UPRR Crossing;

d. The Department shall pay UPRR directly for the trackwork, ballast and Railroad signalization. The Developer shall pay for all other costs of the UPRR Work directly to UPRR. Cost responsibilities of the Department to UPRR are further identified in the UPRR RRA as provided in the Reference Documents; and

e. The UPRR 30% UPRR Crossing Plans, and the UPRR approved 100% trackwork plans are included in the Reference Documents.

10.1.3 UPRR Pepsi Lead At-Grade Crossing

a. Existing conditions have the UPRR Pepsi Lead Crossing traversing east-west from the UPRR 36th Classification Yard south of the I-70 Mainline and crossing Brighton Boulevard at-grade and running along the proposed stormwater detention facility. The Construction Work involves protection of existing Railroad facilities and expansion of the existing at-grade crossing for the addition of a traffic lane and new traffic signal along Brighton Boulevard;

b. The UPRR Pepsi Lead RRA reflects Construction Work for the at-grade crossing modification. The Developer shall complete the design and coordinate with UPRR to obtain approval of the 100% design;

c. UPRR shall be responsible for all Railroad flagging, at-grade crossing modification, and Railroad signalization. The Developer shall be responsible for all other Elements of the UPRR Pepsi Lead Crossing, including but not limited to related Utility Work and construction of the roadway, sidewalk, traffic signalization, signalization interconnect, and a stormwater detention facility. It shall be the Developer's responsibility to coordinate the scheduling of all separate Railroad Forces required for the performance of all Construction Work related to the UPRR Pepsi Lead Crossing; and

d. The Department shall pay UPRR directly for the at-grade crossing modification and Railroad signalization. The Developer shall pay for all other costs of the UPRR Work directly to UPRR. Cost responsibilities by the Department to UPRR are further identified in the UPRR Pepsi Lead RRA as provided in the Reference Documents.

10.1.4 BNSF Railway Market Lead Grade Separation and Industry Track

a. Existing conditions have the I-70 Mainline passing over the BNSF on a viaduct built in the early 1960's, while the BNSF crosses 46th Avenue at-grade to service two businesses on the south side of the I-70 Mainline; Manna Pro Products and Weakland Investments, LLC (RLW Sand Storage). A track responsibility demarcation is defined in the current Industrial Track Agreement between the Railroad and the two businesses. The BNSF is responsible for track maintenance north of the demarcation. Manna Pro and Weakland Investments share responsibility for industry track maintenance within the yard south of the demarcation;

b. The proposed BNSF Crossing over the Lowered Section consists of bridge construction, at-grade crossings with 46th Avenue, trackwork, lights & gate warning devices, Railroad and traffic signalization, signalization interconnect, and coordination with Manna Pro and Weakland Investment's restorative improvements within the yard;

c. The BNSF RRA reflects BNSF approval of:

i. 100% temporary and permanent trackwork design and construction phasing for the BNSF Crossing, which;

A. Permanent trackwork design the Developer shall not be permitted to amend; and

B. Temporary trackwork the Developer shall be permitted to amend or eliminate with the Department's Approval. The following information shall be included in any request by the Developer to make such amendments:

(I) Summary of proposed temporary construction phasing request;

(II) Detailed Construction Work Schedule for the alternative construction phasing;

(III) Accelerated bridge delivery techniques, per Federal Highway Administration (FHWA) guidelines;

(IV) Length of time needed for the existing track to be out of service;

(V) Correspondence with Manna Pro and Weakland Investments for temporary delivery alternative while track is out of service; and

(VI) Explanation of the benefit to the performance of the overall Construction Work;

ii. 30% design for the Construction Work on BNSF right-of-way, including the bridge that carries the trackwork. The Developer shall complete the design and coordinate with BNSF to obtain approval of the 100% design.

d. The track responsibility demarcation will be redefined by the BNSF south of the south at-grade crossing to establish new track responsibility limits for the Railroad and industry tracks. The following responsibilities shall be applied to Construction Work for this crossing:

i. North of the demarcation, the BNSF shall be responsible for all Railroad, trackwork, ballast, Railroad at-grade crossing, lights & gates warning devices, and Railroad signalization; and

ii. North of the demarcation, the Developer shall be responsible for all other Elements of the BNSF Crossing, including but not limited to bridge construction, shoring, grading, subgrade and subballast placement, signalization interconnect, and related

Utility Work. It shall be the Developer's responsibility to coordinate the scheduling of all separate Railroad Forces required for the performance of all Construction Work related to the BNSF Crossing; and

iii. South of the demarcation, Manna Pro and Weakland Investments will be responsible for procurement and coordination of yard track construction, and modifications of their facilities to accommodate the new track. Cost responsibilities of the Department to Manna Pro and Weakland Investments are further identified in the Right-of-Way Agreements included in the Reference Documents;

e. North of the demarcation, the Department shall pay BNSF directly for the temporary and permanent trackwork, ballast, at-grade crossings with 46th Avenue, lights and gates warning devices, and Railroad signalization. The Developer shall pay for all other costs of the BNSF Work north of the demarcation directly to BNSF. Cost responsibilities of the Department to BNSF are further identified in the BNSF RRA included in the Reference Documents; and

f. If the Department Approves any request made by the Developer to amend temporary trackwork the Department will execute an amendment to the BNSF RRA to reflect such Approval. The Developer shall coordinate with and complete property owner agreements for the revised temporary construction phasing.

10.1.5 Denver Rock Island Railroad Silver Yard Grade Separation

a. Existing conditions have the I-70 Mainline passing over a single track from the Denver Rock Island Railroad Silver Yard on a bridge built in the early 1960's. The Construction Work includes reconstruction of the existing I-70 bridge over the DRIR, and construction of two additional bridges to carry ramp and Stapleton Drive North traffic;

b. The DRIR RRA reflects DRIR approval of 30% design for the Construction Work on DRIR Right-of-Way, including the bridges that carry the I-70 Mainline, Stapleton Drive and Quebec Street ramps over DRIR, of which the Developer shall have the responsibility to complete, including coordination with DRIR to obtain approval of the 100% design;

c. DRIR shall be responsible to provide all Railroad flagging. The Developer shall be responsible for all other Elements of the DRIR Crossing, including but not limited to the bridge demolition, bridge construction, shoring, grading, and related Utility Work. It shall be the Developer's responsibility to coordinate the scheduling of all separate Railroad Forces required for the performance of all Construction Work related to the DRIR Crossing; and

d. The Developer shall pay for all costs of the DRIR Work directly to DRIR. Cost responsibilities are further identified in the DRIR RRA as provided in the Reference Documents.

10.2 Applicable Standards

10.2.1 The design and construction of Construction Work shall be in accordance with the Railroad's written specifications, standards of practice, and construction methods of the relevant Railroad. The Developer shall obtain required written specifications, standards of practice, and construction methods from the Railroads. In the event of a conflict between the requirements of a Railroad and the requirements of the Project Agreement, the Department, at its sole discretion, will determine which shall govern. The Developer shall be responsible for resolution of any unresolved ambiguity prior to proceeding with any Construction Work.

10.2.2 The Developer shall comply with the requirements of the Railroad Agreements (RRA)s in performing the Construction Work.

10.2.3 The Developer shall abide by and comply with the standards and requirements of the Public Utility Commission (PUC) in performing the Construction Work.

10.2.4 The Developer shall comply with all rules and regulations prescribed by the Railroads as to the proper manner of protecting the tracks (and the traffic moving thereon), and other property of the

Railroads or their tenants at and in the vicinity of the Site during the time any Construction Work is being performed. Compliance with Railroad rules and regulations shall include execution of contractor's right-of-entry agreements and Permits required by the Railroads.

10.3 Administrative Requirements

10.3.1 The following individuals will act as the Developer's main contacts with each of the Railroads:

a. UPRR
Mr. Sherman Spear
Manager of Public Projects
Union Pacific Railroad
1400 W. 52nd Avenue
Denver, CO 80221
Phone: 303-405-5039
Email: SNSPEAR@up.com

b. BNSF
Mr. Bentley Tomlin
Manager of Public Projects
BNSF Railway
4515 Kansas Avenue
Kansas City, KS 66106
Phone: (913) 551-4964
Email: Bentley.Tomlin@bnsf.com

c. DRIR
Mr. Forest Mars
President
Denver Rock Island Railroad
3400 E. 56th Avenue
Denver, CO 80221
Phone: 303-296-0900
Email: ringo.mars@denverrockisland.com

10.3.2 The Developer shall meet with the Department and each of the Railroads as soon as practicable after NTP 1 to discuss all Railroad points of concern and other items that may affect the Project Schedule. The Developer shall identify critical Activities and sequences as they affect Railroad operations, and shall plan to effectively mitigate Railroad impacts.

10.3.3 Before commencing Construction Work on Railroad right-of-way, the Developer shall enter into a right-of-entry agreement with each of the Railroads. All costs associated with applying for and complying with such right-of-entry agreements and associated Permits, including required insurance coverage, clerical, administrative, and handling expenses in connection with the processing of such agreements and Permits, shall be borne by the Developer.

10.3.4 Railroad Insurance

The Developer shall comply with the provisions for Railroad insurance as specified in the executed right-of-entry agreement with the Railroads and in the terms and conditions of the Project Agreement.

10.3.5 Railroad Flagging and Inspection

a. Any Construction Work or equipment that could potentially fall within 25 feet of the centerline of an active track shall require a Railroad flagger. The Developer shall notify the Railroad, per the executed right-of-entry agreement with the Railroad, to arrange for required flagging services. The Developer shall provide an advance notice, as specified in the executed right-of-entry agreement, to the Railroad for the need of Railroad flagger services. Once the Developer requests a flagger for Construction Work within Railroad right-of-way, the flagger shall remain, for the entire duration of the Construction Work, on

Railroad right-of-way. The Developer shall be responsible to appropriately notify the Railroad regarding flagging start and end dates for work on the Railroad right-of-way. The Developer shall provide advance notice, as specified in the executed right-of-entry agreement, to the Railroad when all Construction Work on the Railroad right-of-way is scheduled for completion to provide for termination of Railroad flagger services;

b. During the period of construction, all flagging and protective services shall be performed strictly in accordance with directives and instructions issued by the applicable Railroad. The Developer shall confer with the Railroads for the times, locations, and manner of such protective measures. The Developer shall include the Railroad flaggers in all its regularly scheduled safety meetings;

c. The Railroad may utilize independent consultant services to inspect and verify that any and all Construction Work on Railroad right-of-way is being undertaken in accordance with Railroad safety requirements. Failure to comply with Railroad safety requirements may result in the Railroad issuing a stop work order;

d. Costs for Preliminary Engineering, Flagging, Inspection and Design Reviews

i. Before submitting design plans to the Railroad for approval, the Developer shall enter into a preliminary engineering review agreement with the respective Railroad for design review costs;

ii. The Developer shall be responsible for Railroad flagging, Railroad inspection, Railroad placement and maintenance of temporary crossings and service roads, Railroad right-of-entry agreements, permitting and coordination fees, Railroad design plan review costs, and other Railroad related costs. The estimated cost for one flagger ranges between $800 - $1,600 for an eight hour basic day with time and one-half or double time for overtime, rest days and holidays. Work days longer than eight hour days, and double shifts will require the utilization of additional Railroad flaggers. The flagging costs, provided in the RRAs, shall be understood to be approximate only, and no guarantee is made that the total cost of such flagging will not be in excess of the estimated amount; and

iii. Notwithstanding the rates specified above in this Section, the rates of pay of the Railroad employees customarily called upon to act for the protection of the Railroad shall be the Railroad rates in effect at the time of the Construction Work for the various classes of labor. Compensation, property damage and public liability insurance, vacation and holiday time, Railroad retirement and unemployment taxes, health and welfare, and supervision charges shall be added to such rates;

e. The Developer shall accommodate any and all requests made by the Railroads that serve the purpose of avoiding hazards to Railroad property and/or operations. Neither the Railroads nor the Department have any liability to the Developer for costs or delays associated with such Construction Work stoppage or requirements associated with avoidance of hazardous situations.

10.3.6 Design Reviews

a. The applicable Railroad will approve design plans for the Construction Work to be performed by the Developer on the Railroad right-of-way. Railroad reviews are separate and independent from submittals required to be made to the Department. The Developer shall coordinate the required Railroad submittals to the Railroads for approval via the appropriate Manager of Public Projects.

b. The Developer shall obtain Railroad approval of design plans in writing for all of the design Elements of the Construction Work within or crossing the Railroad right-of-way prior to initiation of construction.

10.3.7 If the Developer is employed upon or directly adjacent to the Railroad right-of-way and performs the Construction Work thereon contrary to the Railroad-approved plans, specifications, and

requirements of the Project Agreement or applicable RRA, or if the Developer performs the Construction Work on the Railroad right-of-way in a manner deemed hazardous by the Railroad (to its property and facilities or the safe and expeditious movement of its traffic), the Railroad will have the right to stop all Construction Work on the Railroad right-of-way until the acts or omissions of the Developer have been fully rectified to the satisfaction of the Railroad.

10.3.8 The Developer shall be responsible to the Railroad and its tenants for all damages for delays that may be sustained by the Railroad, its tenants, their employees, or freight in their care caused by interference that could have been avoided by performance of the Construction Work in accordance with the requirements of the Project Agreement and the applicable RRA.

10.3.9 All of the limitations and obligations imposed upon the Developer by this Section shall apply with equal force and effect to any Subcontractor performing any Construction Work for the Developer within the Railroad right-of-way. The Developer shall be primarily liable and responsible to the Railroad for all acts or omissions of any Subcontractor. Nothing herein contained shall be construed to preclude the Railroad from proceeding against the Developer, subcontractors, suppliers, or consultants individually or collectively.

10.3.10 The Developer shall not pursue any levies, liens, or encumbrances of any nature whatsoever against Railroad property, and shall promptly remove any lien against Railroad property arising from performance of Construction Work hereunder by the Developer or any Subcontractor; and if not removed within 21 Calendar Days, the Railroad may act to remove same and all the costs shall be paid by the Developer.

10.3.11 The cost of all personnel deemed necessary by the Railroad and provided by the Railroad for the protection of the Railroad facilities and trains during the period of Railroad Construction Work, and the cost of installing protective devices in the case of impaired clearance, as above specified, shall be borne by the Developer.

10.3.12 The requirements of the Railroads and the instructions of their representatives shall be strictly adhered to by the Developer, and its Subcontractors. At the request of the Railroads, the Developer shall remove from the Railroad right-of-way any employee of the Developer or any Subcontractor who fails to conform to the instructions of a Railroad's representative. All Construction Work on the Railroad premises shall be suspended until such request of the Railroad is met. The Developer shall indemnify the Railroad against any claim arising from the removal of any such employee from the Railroad premises.

10.3.13 Railroads are not responsible for Utilities on Railroad right-of-way. The Developer shall identify and locate all existing Utilities on Railroad right-of-way within the immediate vicinity of the Construction Work. The Developer shall certify to the Railroad that all the Utilities on Railroad right-of-way and within the immediate vicinity of the Construction Work have been identified, located and properly addressed for Utility Relocation or Protect-in-Place.

10.4 Construction Requirements

10.4.1 The Developer shall coordinate with the Railroad prior to beginning any construction on or directly adjacent to the Railroad right-of-way. The Developer shall schedule and hold a Railroad pre-construction conference with the affected Railroad. Working windows for demolition and construction shall be coordinated with the Railroads and Railroad flaggers.

10.4.2 The Developer shall obtain Railroad approval in writing, in advance of construction Activities, on methods and procedures for all Construction Work.

10.4.3 Upon completion of the Construction Work, to be performed within or directly adjacent to Railroad right-of-way, the Developer shall promptly remove from Railroad property all tools, equipment, and materials placed thereon by the Developer. The Developer shall restore said property to the same state and condition as when the Developer entered thereon and shall leave said property in a clean and presentable condition satisfactory to the Railroad.

10.4.4 The Developer shall perform Construction Work in accordance with plans and specifications approved by the Railroad and in such manner and at such times as shall not to endanger or

interfere with the safe operation of the tracks and property of the Railroad and the traffic moving on such tracks, as well as wires, signals, and other property of the Railroad, its tenants or licensees, at or in the vicinity of the Construction Work. The Developer shall not pile or store any materials, tools, or park any equipment, when not in use, closer to the center of nearest Railroad track than permitted by the following clearances:

a. 25 feet, 0 inches horizontally from centerline of the nearest rail; and

b. 23 feet, 6 inches vertically above top of rail.

10.4.5 Any proposed variance of the above clearances shall be submitted by the Developer to the Railroad, the PUC (if applicable), and to the Department. The variance shall not be undertaken until approved by the Railroad and until the Department has obtained necessary authorization from all governmental bodies having jurisdiction. Temporary track shoring shall adhere to the requirements defined in the BNSF Railway-Union Pacific Railroad *Guidelines for Railroad Grade Separation Projects.* Variances in temporary shoring types and installation shall require approval by the affected Railroad. The Developer shall be responsible for identifying locations, design and obtaining approval of all temporary track shoring.

10.4.6 The Developer shall remove abandoned portions of existing Railroad track, ties and ballast only as approved and in accordance with the applicable RRA. The Developer shall submit to the applicable Railroad, for approval, any Railroad owned Elements requiring removal, if not covered within the applicable RRA.

10.4.7 If required, temporary at-grade crossings with the Railroad tracks or service roads within Railroad right-of-way will be constructed by the relevant Railroad Forces. If required, the Developer shall execute a Temporary Crossing Agreement with the Railroad. The Developer shall only enter Railroad right-of-way through routes approved by the applicable Railroad. The Developer shall maintain any such crossings so established in good condition at all times; shall keep flange-ways free of ice, snow, dirt, rock and debris; and shall install, operate, maintain and remove in a manner satisfactory to the Railroad suitable gates or barricades adequate to prevent unauthorized vehicles or equipment from using such temporary crossings. All costs and expenses for installation, maintenance, and operation of any such crossings and barricades, whether performed by the applicable Railroad or by the Developer, shall be borne by the Developer. The Developer shall not, at any time, cross a Railroad's tracks with vehicles or equipment of any kind, except at existing public crossings or at crossings established, as provided for in this Section.

10.4.8 The Developer shall provide positive drainage along the Construction Work at all times for the duration of the Project.

10.4.9 UPRR Grade Separation and 36th Classification Yard

a. The UPRR mainlines, yard track, lead track and Railroad signalization shall be reconstructed in accordance with the 100% trackwork design and construction phasing design. Track shooflies and other temporary track, as defined in the 100% design, shall be constructed to move rail traffic away from new bridge construction while maintaining connectivity and operations of all mainline and yard tracks;

b. The Developer shall provide the following Construction Work Elements in accordance with the requirements of the Project Agreement and the UPRR RRA:

i. Existing UPRR bridge demolition;

ii. UPRR bridges over the I-70 Mainline, 46th Avenue, and sidewalks;

iii. Service road approaches providing a minimum 12' wide driving surface;

iv. Grading, drainage and subballast for all temporary and permanent track;

v. Modification of 47th and York Street at-grade crossing roadway and sidewalk approaches and Railroad signalization coordination; and

vi. Relocation of independently owned Utilities across the UPRR bridges and as required to connect to the existing Utilities, in accordance with Schedule 10, Section 4 Utilities.

c. During the UPRR bridge construction, the Developer shall provide a temporary 12 foot wide minimum service road crossing under the existing I-70 viaduct until the permanent service road and bridge can be placed in service;

d. Temporary and permanent trackwork and Railroad and traffic signalization are required to construct the UPRR Crossing over the Lowered Section;

e. Warning devices for roadway-rail grade crossings shall be designed, specified, installed and tested by the UPRR. Devices, at a minimum, shall include gate arms and mechanisms, gate arm lights, LED flashing light units, electronic bells, signs, approach circuits, standby/backup battery, and associated control circuitry. All costs associated with procuring materials, labor to install, testing, permitting and PUC approval process, and administrative expenses in connection with the design and installation of these crossings, shall be included in the UPRR RRA;

f. At-grade crossing shall meet the requirements of Americans with Disabilities Act (ADA) *Accessibility Guidelines* and the Colorado PUC;

g. The Developer shall maintain existing Railroad operations, without any closures, at all times; and

h. Refer to Schedule 10, Section 13 Structures for requirements and coordination, as it relates to the UPRR Railroad and service road bridges.

10.4.10 UPRR Pepsi Lead At-Grade Crossing

a. The UPRR Pepsi Lead Industry Track shall be protected, and the at-grade crossing with Brighton Boulevard modified while maintaining connectivity and operations of the existing track;

b. The Developer shall provide the following Construction Work Elements in accordance with the Project requirements of the Project Agreement and the UPRR RRA:

i. Modification of Brighton Boulevard roadway and pedestrian approaches to the at-grade crossing; and

ii. Relocation of independently owned Utilities as required to connect to the existing Utilities, in accordance with Schedule 10, Section 4 Utilities.

c. At-grade crossing shall meet the requirements of Americans with Disabilities Act (ADA) *Accessibility Guidelines* and the Colorado PUC; and

d. The Developer shall maintain existing Railroad operations, without any closures, at all times.

10.4.11 BNSF Market Lead Grade Separation and Industry Track

a. The BNSF Market Lead track shall be reconstructed in accordance with the 100% trackwork design and construction phasing design. Unless otherwise approved by the Department and the BNSF, a track shoofly, as defined in the 100% design, shall be constructed to move rail traffic away from new bridge construction while maintaining connectivity and freight rail delivery to Manna Pro Products and RLW Sand Storage operations;

b. The Developer shall perform the following Construction Work Elements in accordance with the requirements of the Project Agreement and the BNSF RRA:

i. BNSF bridge over the I-70 Mainline;

ii. Grading, drainage and subballast for permanent track north of the demarcation; and

iii. Grading, drainage and subballast for all temporary track; and

iv. Relocation of independently owned Utilities shown to be in conflict with the Construction Work, including across the BNSF bridge and as required to connect to the existing Utilities, in accordance with Schedule 10, Section 4 Utilities.

c. Warning devices for roadway-rail grade crossings shall be designed, specified, installed and tested by BNSF. Devices, at a minimum, shall include gate arms and mechanisms, gate arm lights, LED flashing light units, electronic bells, signs, approach circuits, standby/backup battery, and associated control circuitry. All costs associated with procuring materials, labor to install, testing, permitting and PUC approval process, and administrative expenses in connection with the design and installation of these crossings, shall be included in the BNSF RRA;

d. At-grade crossings shall meet the requirements of Americans with Disabilities Act (ADA) *Accessibility Guidelines* and the Colorado PUC; and

e. Refer to Schedule 10, Section 13 Structures for requirements and coordination, as it relates to the BNSF Railroad bridge.

10.4.12 DRIR Silver Yard Grade Separation

a. The DRIR Track shall be protected, the existing bridge demolished, and the I-70 Mainline, Quebec Street ramps, and Stapleton Drive North bridges constructed while maintaining connectivity and operations of the existing track;

b. The Developer shall provide the following Construction Work Elements in accordance with the requirements of the Project Agreement and the DRIR RRA:

i. Existing bridge demolition;

ii. Reconstruction of eastbound and westbound I-70 bridges over the DRIR track;

iii. Construction of new Quebec Street eastbound exit ramp and Stapleton Drive North bridges over the DRIR track;

iv. Grading and drainage;

v. Relocation of independently owned Utilities as required to connect to the existing Utilities, in accordance with Schedule 10, Section 4 Utilities.

c. Horizontal openings under each bridge should accommodate a future parallel track east of the existing DRIR Lead Track spaced at 20 feet on center as defined in Appendix A.

d. Refer to Schedule 10, Section 13 Structures for requirements and coordination, as it relates to the DRIR Railroad bridge.

10.4.13 Subgrade Cross Slope and Track Superelevation

a. All new and reconstructed track sections shall be designed and constructed with subgrade/subballast cross slopes in accordance with the requirements of the applicable Railroad and 100% approved design;

b. Superelevation shall be applied to mainline track only, unless otherwise directed by the applicable Railroad. Superelevation rate and transition length for mainline track reconstruction shall be in accordance with the 100% approved design;

c. Ballast Slopes (Track Roadbed)

i. Ballast slopes shall be constructed in accordance with 100% approved design or as specified by the applicable Railroad's standards; and

ii. Ballast roadbeds areas shall be designed and constructed with ditches, underdrains and storm sewer as necessary to direct drainage away from the track roadbed.

d. Cut slopes beyond the trackside ditch shall be designed and constructed in accordance with 100% approved design or as specified by the applicable Railroad's standards; and

e. All cut slopes shall be rounded at their matches to existing ground.

10.4.14 Colorado Public Utilities Commission Approvals

a. All new, modified, and/or reconstructed at-grade crossings, grade separated railroad/highway crossings, and pedestrian crossings of commercial rail lines will require approval of the Colorado PUC.

b. In accordance with PUC Regulations (4 CCR 723-7:7203), only the roadway or Railroad authority in highway-rail crossings may petition or apply to the PUC. The Department will apply for the highway-rail crossing PUC authorizations necessary for the Project. The Developer shall support the Department in these efforts by the following:

i. The Developer shall be responsible for preparing all applications to be submitted to the PUC, including developing the application text and all supporting documentation, and preparing exhibits to the satisfaction of the PUC and for Approval by the Department;

ii. The Developer shall attend meetings with appropriately qualified staff and cooperate with the PUC as reasonable and requested by the Department;

iii. The Developer shall prepare and coordinate any post application exhibits and/or information requested by the PUC, including providing technical expertise at any PUC legal proceedings, as requested by the Department; and

iv. The Developer shall allow for appropriate PUC approval durations in the Construction Work Schedule and shall provide the applications and supporting documentation in a timely fashion to the Department to prevent delays to the Construction Work. Any delays or increase in costs of the completion of the Project caused by the failure of or delay by the Developer to provide the PUC applications and supporting documentation to the Department shall be the responsibility of the Developer.

10.4.15 Fencing

a. The Developer shall provide temporary fencing as required by the RRAs to protect Railroad right-of-way from unauthorized access and cut-through traffic during construction. Temporary fence shall be of material, dimensions and placement that will prevent vehicle and pedestrian entry. Gates for construction access shall be placed in locations designated in the Developer's plans and approved by the Railroad.

b. At the discretion of the Railroad, the Developer shall provide permanent fencing of types, in accordance with Railroad standards and requirements, in the following locations:

i. UPRR right-of-way line north and south of proposed Railroad bridge;

ii. BNSF right-of-way line south of proposed 46th Avenue (east side only);

iii. BNSF right-of-way line north of proposed 46th Avenue;

iv. DRIR right-of-way line north and south of proposed I-70 Mainline; and

v. UPRR right-of-way line south of the I-70 Mainline, between Havana Street and Peoria Street.

c. The Develoepr shall provide gates in fences at locations and of width and type as approved by the Railroad for maintenance access.

d. All fencing materials, temporary and permanent, shall be selected in accordance with the guidelines established in Schedule 10, Section 14 Landscaping and Aesthetics.

10.5 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the timeframes specified:

Table 10-1 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Copies of notices, and correspondences	Information	Prior to RFC Documents
PUC applications (all locations)	Approval	Prior to RFC Documents

10.6 Appendices

Appendix A Railroad Design Criteria

Appendix A
Railroad Design Criteria

Design Element	UPRR and DRIR	BNSF	Remarks
Standards Applied	UPRR/BNSF/AREMA		
General			
Track Classification	Yard/Mainline	Yard / Industry	
Design Speed (MPH)			
Mainline Track (Low Speed) (Yard Approach)	10		
Yard and Industry Track		6	
Horizontal Alignment Criteria			
Curve Radius (Feet/Deg of Curve) - Minimum			
Mainline Track	573.69' (10.0°)	N/A	
Yard and Industry Track	573.69' (10.0°)	603.80' (9.30°)	
Mainline Shoofy Track	955.37' (6.0°)	N/A	
Yard Shoofly Track	521.67' (11.0°)	N/A	
Tangent Between Curves (Feet) - Minimum			
Mainline Track	150	50	
Yard and Industry Track	36	50	
Superelevation (Ea/Eu)			
Mainline Track	0"/3/4"		
Yard and Industry Track	N/A	N/A	
Track Spacing (Feet)			
Mainline Track	20	14	
Yard and Industry Track	15	15	
Turnouts (Turnout No.) - Minimum			
Mainline Track	#11		
Yard and Industry Track	#9	#9	
Mainline Shoofy Track	#11		
Yard Shoofly Track	#9		
Shoulder Widths (Inches)			
Mainline Track	18		
Yard and Industry Track	12	TBD	
Mainline Shoofy Track	12		

Design Element	UPRR and DRIR	BNSF	Remarks
Side Slopes			
Ballast Slope	3:1	2:1	
Cut Slope	2:1	1.5:1	
Fill Slope	2:1	1.5:1	
Z-slope (3:1 Slope) (Feet)	3	2	
Clearance from Track CL to Structure (Feet)			
Permanent Track			
Railroad Under Roadway Structure - All Tracks	25 (18 with pier protection)	25 (15 with pier protection)	
Railroad Structure Over Roadway - All Tracks	8	8	
Temporary Track (During Construction)			
Railroad Under Roadway Structure - All Tracks	12	15	
Vertical Alignment Criteria			
Length of Vertical Curves (Feet) - Minimum			
Mainline Track	100	100	
Yard and Industry Track	100	100	
V/L Values (Sag/Crest) - Maximum			
Mainline Track (Low Speed)	0.12/0.20	0.10/0.20	
Yard and Industry Track	1.2/2.0	2.0/2.0	
Grade - Maximum			
Mainline Track	2%	2%	
Yard and Industry Track	2%	2%	
Vertical Clearance at Structures (Feet) - Minimum			
Permanent Track			
UPRR/BNSF under Highway/Street	23'-4"	23'-4"	
UPRR/BNSF over Highway/Street[1]	16'-6"	16'-6"	
UPRR/BNSF over Highway/Street[2]	17'-6"	17'-6"	
UPRR/BNSF over Highway/Street[3]	20'-0"	20'-0"	
Temporary Track			
UPRR/BNSF under Highway/Street	21'-6"	21'-6"	

1 - Steel superstructure with 5 or more beams or 4 or more deck plate girders per track
2 - Concrete superstructure or steel through plate girder with bolted bottom flanges
3 - Steel through plate girders without bolted bottom flanges

11. SIGNING, PAVEMENT MARKINGS, SIGNALIZATION, AND LIGHTING

11.1 General

The Developer shall be responsible for the design and installation of all permanent and temporary signing, pavement marking, signalization, and lighting Elements required for the Project. Permanent and temporary signing, lighting, and other traffic control devices shall be provided to facilitate and maintain the safe flow of traffic for the completed Construction Work elements for all phases of the Construction Work. The Developer shall replace existing signing and pavement markings outside of the Site that are rendered inaccurate, ineffective, or confusing by the Construction Work.

11.2 Applicable Standards

11.2.1 Unless otherwise stated, the Construction Work requirements shall apply to permanent as well temporary signing, pavement marking, signalization and lighting. The design shall comply with the requirements of this Section and the standards included in Schedule 10A Applicable Standards and Specifications.

11.2.2 The design shall include electrical designs and power requirements for the respective Construction Work Elements. The Developer shall coordinate with the relevant electrical Utility companies and ETC System Integrator to determine electric power requirements for the Construction Work.

11.2.3 Signing and pavement marking designs shall comply with the requirements of the Colorado Department of Transportation (CDOT) *Standard Specifications*, *M & S Standard Plans*, *Sign Design Manual*, and the most current version of the Federal Highway Administration (FHWA) *Manual for Uniform Traffic Control Devices* (MUTCD).The requirements of the MUTCD shall include both the standard requirements and the guidance recommendations of the manual. The design shall address all necessary modifications to existing permanent signing inside and outside the Site.

11.2.4 Signs and signals on Local Agency Roadways shall comply with the Local Agency Standards.

11.3 Signing

11.3.1 Signing Design

a. Permanent signing shall include all necessary guide, warning, supplemental, tolling, informational, school zones, Railroad, and regulatory, etc., signs for the Project, including signing on adjacent Local Agency Roadways, arterials and highways outside the Site. These signs shall be required to be installed as new at the appropriate locations in coordination with the design and Accepted by the Department prior to installation;

b. The local roads, arterials, and highways currently display existing signing to direct vehicles to I-70. These signs shall be modified or replaced to incorporate the new legend;

c. The requirements of the MUTCD shall include both the standard requirements and the guidance requirements of the manual:

d. The Interstate Access Request (IAR) includes the I-70 Phase 1- Signing, Striping, ATM and Tolling Concept Plan, which shows most Class III signs required outside of the Site. Signs shall be required to inform Tolled Express Lane users on all the approaches from all directions of I-70, I-225, I-25 and interstate to interstate ramps. Any changes to the IAR, signing and striping plan requires approval by FHWA. The Developer shall be responsible to provide the Department with all documentation and information required to obtain the IAR approval.

e. The Developer shall submit sign layouts for all special signs of any size to the Department for Acceptance;

f. During the Construction Period the Developer shall re-set the existing permanent signs on the I-70 Mainline that display the LOGOS. The Developer shall coordinate with the

contractor responsible for managing the LOGOS program for the correct placement of these signs. Contact information for the LOGOS program can be found at www.colorado.interstatelogos.com. At the end of the Construction Period these signs shall be incorporated into the Permanent Signing Plan at the direction of the LOGOS program manager following the Approval of the Department;

g. The Developer shall coordinate with the Regional Transportation District (RTD) to re-locate wayfinding signs for RTD stops and stations in and outside the Site. If existing wayfinding signs require removal, alternative equivalent signs shall be relocated and replaced, as directed by RTD;

h. Mile markers are required for the entire length of the Project and shall be displayed every 0.1 mile. In addition, delineators are required; Mile markers and delineators shall be installed in accordance with Applicable Standards and Specifications;

i. Signing designs shall include details of size, legend and locations of ground-mounted and overhead signs, dimensions of Class III sign supports, layouts/dimensions of all special signs, and structural and foundation requirements. Details to be submitted shall include structure cross sections, display signing mounting, hangers, equipment, control boxes, conduits, holes, hand holes, vertical clearances, the Right-of-Way (ROW) line, Utility conflicts, panel sizes, tolling attachments, Intelligent Transportation Systems (ITS) attachments, conduit locations, caisson foundation sizes and depths, shoulder, General Purpose Lane and Tolled Express Lane widths, correct sign placement over each lane, direction, barrier protection type, station and offset, etc. Refer to Schedule 10, Section 13 Structures for requirements and coordination;

j. Where CDOT sign structure standards cannot be met, the Developer shall submit alternative designs, such as custom designed monotube sign structures and foundations, for Approval. Permanent signage on Bridges shall not be hung from or be attached to the face of Bridge superstructures. Existing signs attached to Bridge superstructures shall be removed and replaced with monotube sign bridges or cantilever structures with new signs. Refer to Schedule 10, Section 13 Structures for requirements and coordination;

k. The Developer shall mount all overhead signs along the I-70 Mainline with a minimum vertical clearance of 17.5 feet and a maximum of 18.5 feet measured from the roadway surface under the sign panels and/or electronic signs to the bottom of the Variable Message Sign (VMS), Variable Toll Message Sign (VTMS), lane use signal (LUS) or guide sign (whichever is lowest). Structure cross sections shall be submitted and display signing mounting, hangers, equipment, control boxes, conduits, holes, hand holes, vertical clearances and all dimensions. If Active Traffic Management (ATM) signage/signals or tolling equipment are planned on structures the vertical clearance is measured to the bottom of the LUS, tolling equipment and any future equipment. Refer to Schedule 10, Section 3 ITS and Tolling Equipment for requirements and coordination;

l. Sign lighting on overhead guide signs shall not be permitted; and

m. Unless stated otherwise, walkways shall not be permitted on overhead guide sign structures.

11.3.2 Signing Materials

a. The materials for sign posts for each class of sign shall comply with the respective requirements of the Applicable Standards and Specifications. The use of wood posts for mounting ground signs is not permitted and all Class I and Class II sign posts shall use schedule 80 in lieu of schedule 40 material

b. All Class I, II, and III ground signs shall include breakaway devices per CDOT *S-Standard Plans*;

c. Signs on Local Agency Roadways shall be per Local Agency standards for materials, except for Class III signs, which shall be per CDOT S-Standard Plans;

d. Retroreflective sheeting shall be Type IV and Type XI as defined in the CDOT *Retroreflective Sheeting Materials Guide* and shall conform to Subsections 713.04 and 713.06 when applicable. For all permanent signs, the legend, borders, and background shall be Type XI. The retro reflective sheeting standards are subject to change and the most current type prior to manufacturing shall be used; and

e. Re-use or resetting of any of the existing sign structures, ground signs, and their components shall not be permitted. All signs and structures shall be new and customized to fit the conditions of the construction.

11.3.3 Existing Signing

Conditional to the issuance of NTP 2, the Developer shall submit an inventory of all existing signs, in Microstation format, to the Department. The Developer shall be responsible for the removal and disposal of the existing sign structures, ground-mounted signs, and delineators affected by the Construction Work.

11.4 Pavement Marking

11.4.1 Pavement Marking Design

a. Pavement marking design shall include all striping required for center lines, edge lines, lane lines, channelization, gore areas, lane drops, merging lanes, transition lanes, dotted lane extensions, Tolled Express Lanes, arrows, legends, symbols, crosswalks, stencils, stop lines, object markings, delineation, Railroad and other striping, as well as any modifications required for transitions to existing pavement markings;

b. The Tolled Express Lanes shall incorporate ingress, egress, and weave (within the ingress/egress zones) lanes. The IAR depicts the striping plans;

c. Where existing pavement is to be retained requiring only reconfiguration of existing striping, the stripes shall be removed and replaced according to best industry practice. Stripes shall not be placed on joint lines; and

d. Pavement marking stencils shall be installed as follows: left and right turn lanes, interstate to interstate ramp shields, cross walks, bike symbols, words, school zones, stop bars, highway interstate shields on approach turn lanes, etc.;

11.4.2 Pavement Marking Materials

All new pavement markings shall be compliant with Table 11-1 and follow the procedure for measurement as outlined in the Project Special Provision Revision of Section 106, 627 and 713 as provided in Appendix A Project Special Provisions.

Table 11-1 Pavement Marking Materials

Color	Retro-reflectivity Reading (R) in a one-mile section (mcd/m^2/lux)
White	R $\geq$ 375 (Newly applied marking less than 3 weeks old) Newly applied marking minimum 375 mcd/m^2/lux. Less than this reading for newly applied marking; remove and replace, impose a Working Time Violation Incident and stop work.
Yellow	R $\geq$ 275 (Newly applied marking less than 3 weeks old) Newly applied marking minimum 275 mcd/m^2/lux. Less than this reading for newly applied marking; remove and replace, impose a Working Time Violation Incident and stop work

11.4.3 Existing Pavement Marking

Conditional to the issuance of NTP 2, the Developer shall submit an inventory of all existing striping, in MicroStation format, to the Department.

11.5 Traffic Signalization

11.5.1 Traffic Signal Design

a. Traffic signalization design shall include traffic signal mast arm type poles, pedestal poles, pole footing/caisson locations and sizes, mast arm lengths, traffic signal heads, countdown pedestrian signal heads, signal head placement and alignment, controller cabinet(s), power disconnect and meter, signal phasing, lighting/luminaires, conduits, pull boxes, non-invasive vehicle detection, pedestrian push buttons, emergency vehicle preemption, railroad signal preemption design, Americans with Disabilities Act (ADA) compliant curb ramps, signal timing plan, and signing as required;

b. Existing Local Agency signal interconnect system shall be replaced in kind anywhere it is modified or damaged due to the construction of the interchanges and new/modified signals are added. In addition all ramp meters shall be interconnected with a 12 stand single mode fiber optic cable to the local signal cabinet at each ramp termini;

c. Traffic signal pole locations shall be staked and Accepted by the Department and the CCD before construction;

d. Currently identified locations of new traffic signalization:

i. Brighton Boulevard and 46th Avenue (North and South);

ii. York Street and 46th Avenue (North and South);

iii. York Street and 47th Avenue with pre-signal at Railroad crossing;

iv. Josephine Street and 46th Avenue (North and South);

v. Columbine Street and 46th Avenue (North and South);

vi. Clayton Street and 46th Avenue (North and South);

vii. Fillmore Street and 46th Avenue (North and South);

viii. Steele Street/Vasquez Boulevard and 46th Avenue (North and South);

ix. Cook Street and 46th Avenue (North and South);

x. Monroe Street and 46th Avenue (North and South);

xi. Colorado Boulevard and 46th Avenue (North and South);

xii. Dahlia Street and Stapleton Drive (North and South);

xiii. Holly Street and Stapleton Drive (North and South);

xiv. Monaco Street and Stapleton Drive (North and South);

xv. Quebec Street and I-70 Mainline ramps (North and South); and

xvi. Peoria Street and I-70 Mainline ramps (North and South).

e. The Developer shall provide a signal warrant study for all signal installations and they shall be approved by the CCD;

f. Temporary Traffic Signal and Timing Plans shall be designed, as necessary, to facilitate re-construction of any existing signalized intersection. Span wire type installations are permitted for temporary signals only. Poles shall be placed at locations that will facilitate all stages of intersection reconstruction and must meet clear zone requirements. Noninvasive loops are permitted for temporary installations. All traffic signal pole locations shall be stacked in the field and approved by the CCD and Accepted by the Department before

installations. All Traffic Signal Timing Plans shall be approved by CCD prior to implementation. The plans shall be submitted for Acceptance prior to implementation for both temporary and permanent installations;

g. Modifications to existing infrastructure in any way shall not be allowed and will require new installations. This can include additions such as signal heads, foundations, longer mast arms, lighting, drilling holes, adding wire, etc. Existing equipment such as poles, mast arms and foundations cannot be re-used or upgraded and shall be new; and

h. The Ultimate configuration shall be accommodated.

11.5.2 Traffic Signal Materials

All lighting on the traffic signal poles shall be approved by Xcel prior to design submittals to the Department. This includes wiring, luminaires, luminaire lengths, luminaire heads, conduit sizes, and all other materials related to the lighting for the signals.

11.5.3 Existing Traffic Signalization

a. Existing signal operations shall be maintained throughout construction. The Developer shall coordinate the removal of the signal poles with Xcel Energy and CCD; and

b. Xcel Energy is the owner of the signal poles and lighting. CCD is the owner of the remaining equipment. All equipment removed that is owned by CCD shall be delivered within 72 hours to Chris Lillie, Denver Public Works (phone 720-865-4066).

11.6 Ramp Meters

11.6.1 Ramp Meter Design

a. Permanent ramp meter signalization design for all entrance ramps affected by the Construction Work shall include traffic signal poles, mast arms, pedestal poles, pole footing/caisson locations and sizes, traffic signal heads, signal head placement and alignment, controller cabinet(s), power disconnect and meter, signal phasing, conduits, pull boxes, in pavement vehicle loop detection, on ramp signal system fiber optic interconnect. Designs for two lane entrance ramps shall include overhead mast arm designs with additional side pole heads for both lanes;

b. Temporary Ramp Meter and Timing Plans shall be designed, as necessary; to facilitate traffic flow during re-construction of any existing ramp meters. Noninvasive loops are permitted for temporary installations only;

c. New designs shall include Ramp Meter Timing Plans for the AM, PM and off peak ramp meters affected by the Construction Work;

d. New permanent ramps shall not be opened until a permanent ramp meter has been installed and connected to the fiber optic backbone and communications is established with the Department;

e. Permanent Ramp Meter Timing Plans shall be implemented prior to opening of the ramp;

f. Any loops in the I-70 Mainline can be temporary non-invasive in order to effectively use the ramp meter;

g. Permanent ramp meters shall be required at I-70 Mainline entrance ramps as follows:

i. Westbound Washington Street;

ii. Eastbound Washington Street;

iii. Westbound Brighton Boulevard;

iv. Eastbound Brighton Boulevard;

v. Westbound Vasquez Boulevard;

vi. Westbound Colorado Boulevard;

vii. Eastbound Colorado Boulevard;

viii. Westbound Holly/Dahlia Street;

ix. Eastbound Holly Street/Monaco Street;

x. Westbound Quebec Street;

xi. Eastbound Quebec Street; and

xii. I-270 Eastbound to I-70 Eastbound.

h. Existing ramp meter signal operations shall be maintained throughout construction. The Developer shall be responsible for the removal and disposal of existing signal equipment and structures that are to be replaced. Existing ramp meters are located in the following locations:

i. Westbound Central Park Boulevard;

ii. Eastbound Central Park Boulevard;

iii. Westbound Havana Street;

iv. Eastbound Havana Street;

v. Westbound Peoria Street; and

vi. Eastbound Peoria Street.

i. Existing ramp meters shall be connected to the new CDOT fiber optic backbone as described in Schedule 10, Section 3 ITS and Tolling Equipment;

j. The ramp meters at eastbound Brighton Boulevard and westbound Vasquez Boulevard are required to be connected to the Cover Command Control and Monitoring System. Refer to Schedule 10, Section 12 Cover MEP System for other ramp meter requirements; and

k. All ramp traffic signal poles shall be galvanized.

11.7 Lighting

11.7.1 Lighting Design

a. Conditional to the issuance of NTP 2, the Developer shall submit an inventory of all existing lighting affected by the Construction Work, in MicroStation format, to the Department. The report shall indicate if each individual light is working or not working during night time conditions. The report shall also include the lighting circuitry within the Site;

b. The Developer shall prepare mid mast median lighting design for the I-70 Mainline between Brighton Boulevard and Chambers Road including the transition into the existing high mast interchange lighting at I-225/I25. New high mast lighting shall not be permitted;

c. Lighting design shall include ramps, sidewalks, local roads, highways arterials, parks, pedestrian, bike and take into consideration all existing permanent lighting conditions on roadways impacted by the Construction Work. The design shall cover both temporary and permanent lighting; and details shall include existing topography, ROW, Utilities and drainage facilities, structures, all other existing and proposed facilities, location and orientation of standards and fixtures, wiring, conduits, pedestals, power sources, and all other lighting components as required;

d. Permanent lighting shall be designed and constructed to be consistent with current CDOT *M-Standard Plans*, Xcel Energy lighting standards and CCD lighting standards, as applicable;

e. Existing lighting impacted by the Construction Work shall be provided to include partial interchange lighting for all ramp entrances and exits at all the interchange ramps within the Site and local roads;

f. The lighting design submittal shall include lighting calculations for both permanent and temporary conditions. Design details shall include lighting calculations and electrical design including voltage-drop calculations for each circuit to Xcel Energy for approval prior to the installation of the wiring for the connections to the power sources; and

g. New lighting underneath structures shall be placed where a lane closure is not required for maintenance. Existing lighting under structures shall be re-set to a location where a lane closure is not required for maintenance. Both of these requirements for existing and new lighting shall also meet the photometrics regarding design.

11.7.2 Lighting Materials

a. The Developer shall use lighting equipment for all permanent installations as specified in the CDOT *Standard Specifications* or by Xcel Energy as applicable;

b. The Developer shall obtain approval of the lighting equipment from the Local Agency responsible for maintenance; and

c. For areas within incorporated municipal boundaries that Xcel Energy is responsible for maintenance, the Developer shall submit the materials lists for the proposed lighting, including under deck lighting and all associated material for approval by Xcel Energy prior to ordering material. The lighting materials shall also be approved by the CCD.

11.7.3 Existing Lighting

Xcel Energy will remove the existing lighting as required within the Site that is owned by Xcel Energy. The Developer shall be responsible for the coordination of lighting removal and lighting relocation Work to be performed by Xcel Energy, in accordance with the applicable URA.

11.7.4 Railroad At-Grade Crossings and Traffic Signal Interconnect.

a. All at-grade Railroads crossings shall be interconnected as per the MUTCD and Public Utilities Commission requirements. The Railroad preemption signal to traffic signal interconnect shall be coordinated with the appropriate Railroad. This includes temporary and permanent traffic signal installations. The Railroad will approve Railroad preemption signal to traffic signal interconnect design, interconnect plan and testing prior to the signal being turned on or modified in any way in accordance with Schedule 10, Section 10 Railroads.

b. The Developer shall be responsible for Construction Work required to interconnect the traffic signal with the Railroad. The Developer shall coordinate the Construction Work, seek approval for the design and construct and terminate the signal interconnect according to the Railroads and CCD requirements in accordance with Schedule 10, Section 10 Railroads.

11.8 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the specified timeframes:

Table 11-3 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Class III, overhead signs, sign structure cross sections, and Tolled Express Lane regulatory and Guide Signs Plan	Acceptance	Prior to RFC Documents
Existing signing, striping and lighting inventory	Information	Prior to RFC Documents
Sign layouts for all special signs of any size	Acceptance	Prior to RFC Documents
Temporary and Permanent Traffic Signalization Plans and Timing Plans	Acceptance	Prior to RFC Documents
LOGOS signing location	Approval	Prior to RFC Documents
Temporary and Permanent Ramp Meter Plans and Timing Plans	Acceptance	Prior to RFC Documents
Permanent Lighting Plans and Temporary Lighting Plans	Acceptance	Prior to RFC Documents
Traffic Signal Timing Plans and associated electronic timing plan software files	Acceptance	Prior to RFC Documents
Lighting design, photometric, lighting materials and electrical design calculations	Acceptance	Prior to RFC Documents
Documentation and information required for IAR approval	Approval	Prior to RFC Documents

11.9 Appendices

Appendix A Project Special Provisions

Appendix A
Project Special Provisions for Signing, Pavement Markings, Signalization and Lighting

The following specifications modify and take precedence over the Standard Specifications. The provisions of Appendix A to Schedule 10A Applicable Standards and Specifications apply to these Project Special Provisions.

PROJECT SPECIAL PROVISIONS

REVISION OF SECTIONS 106, 627 AND 713
EPOXY PAVEMENT MARKING

Sections 106 and 627 of the Standard Specifications are hereby revised for this project as follows:

Subsection 106.03 shall include the following:

The Contractor shall take retroreflectivity readings for each mile of pavement marking line placed or fraction thereof. Retroreflectivity readings shall be taken using an available Contractor furnished, industry-accepted retroreflectometer which shall be calibrated each day testing occurs. The Engineer will determine a random testing location for each one mile section of line of pavement marking applied or fraction thereof. Each test location shall represent that one mile or fraction thereof of pavement marking. At each random testing location 10 retroreflectivity readings will be taken approximately 40 feet apart within a 500 foot section of the continuous line. Those 10 readings will be averaged and that average value will represent the retroreflectivity of that one mile section or fraction thereof.

The retroreflectivity readings shall be taken in the presence of the Engineer no sooner than three days and no later than 14 days after the marking is tack free. Traffic control required for retroreflectivity readings shall be included in the cost of work. Initial minimum retroreflectivity reading (mcd/m^2/lux) marking shall be as follows and removal and replacement is required as per the table when readings are less than required:

Color	**Retro-reflectivity Reading (R) in a 1-mile section (**mcd/m^2/lux**)**
White	R $\geq$ 375 Initial Reading minimum (Between 3-14 days)
	R < 275 Remove and Replace
Yellow	R $\geq$ 250 Initial Reading minimum (Between 3-14 days)
	R < 150 Remove and Replace

Traffic control required for retro-reflectivity readings shall be included in the cost of work.

In subsection 627.05, delete the last two paragraphs and replace with the following:

Epoxy pavement marking shall be applied to the road surface according to the epoxy manufacturer's recommended methods at 17-18 mils thickness. Glass beads shall be applied into the epoxy pavement marking by means of a pressurized bead applicator at a rate of ¼ pound per square foot, 23 pounds per gallon minimum.

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REVISION OF SECTIONS 106, 627 AND 713
EPOXY PAVEMENT MARKING

Epoxy pavement marking and beads shall be applied within the following limits:

Application Rate or Coverage
Per Gallon of Epoxy Pavement Marking

	Minimum	Maximum
17-18 mil marking	85 sq. ft.	90 sq. ft.
Beads	23 lbs.	

Delete subsection 713.17 and replace with the following:

713.17 Epoxy Pavement Marking Material. Only epoxy pavement marking material that is on the Department's Approved Products List may be used. Batches or lots of approved products will be accepted on the project by certified test report (CTR). The CTR shall confirm that the material meets all CDOT requirements and is the same material that was preapproved in the product evaluation process.

(a) *Formulation.* Epoxy pavement marking material shall be a two component, 100 percent solids, material formulated to provide simple volumetric mixing ratio of two volumes of component A and one volume of component B unless otherwise recommended by the material manufacturer.

(b) *Composition.* The component A of both white and yellow shall be within the following limits:

Resin / Pigment Components (% by Weight)

Pigment	White	Yellow
TiO_2, ASTM D476, Type II	18-25	10-17
Organic Yellow		6-10
Epoxy Resin	75-82	73-84

The pigment for yellow epoxy shall contain no lead or other material such that the cured epoxy could be considered a hazardous waste under EPA or CDPHE regulations. The Contractor shall submit to the Engineer a manufacturer's certification of compliance with this requirement.

(c) *Epoxide Number.* The epoxy number of the epoxy resin shall be the manufacturers target value ± 50 as determined by ASTM D 1652 for white and yellow component A on pigment free basis.

(d) *Amine Number.* The amine number on the curing agent (component B) shall be the manufacturers target value ± 50 per ASTM D 2071.

(e) *Toxicity.* Upon heating to application temperature, the material shall not produce fumes which are toxic or injurious to persons or property.

(f) *Color.* The epoxy material, without drop-on beads, shall correspond following requirements:

White – Federal Standard No. 595B-17925. The Yellowness Index (YI) of white shall not exceed 8.0 per ASTM E-313-10 initially.

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REVISION OF SECTIONS 106, 627 AND 713
EPOXY PAVEMENT MARKING

After 72 QUV exposure per ASTM G-154 with a UVA-340 Lamp at an irradiance of 0.89 W/m2/nm with alternating cycles of 4 hours U.V @ 140º F, and 4 hours humidity @ 122º F the YI shall not exceed 20 when measured per ASTM E-313.

The YI, after 500-hour QUV testing as above, shall not exceed 35.

Yellow – Materials for pavement markings shall meet the initial daytime chromaticity that fall within the box created by the following corner points:

Initial Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
x	0.530	0.510	0.455	0.472
y	0.456	0.485	0.444	0.400

After 72-hour QUV exposure per ASTM G-154 with a UVA-340 Lamp at an irradiance of 0.89 W/m2/nm with alternating cycles of 4 hours U.V @ 140º F, and 4 hours humidity @ 122º F the Yellow shall fall within the initial chromaticity coordinates stated above.

(g) *Drying Time.* The epoxy pavement marking material shall have a setting time to a no-tracking condition of not more than 25 minutes at a temperature of 73° F and above.

(h) *Curing.* The epoxy material shall be capable of fully curing under the constant surface temperature condition of 35° F and above.

(i) *Adhesion to Concrete.* The catalyzed epoxy pavement marking material, when tested according to ACI Method 503, shall *have* such a high degree of adhesion to the specified (4000 psi minimum) concrete surface that there shall be a 100 percent concrete failure in the performance of this test

(j) *Hardness.* The epoxy pavement marking materials, when tested according to ASTM D 2240, shall have a minimum Shore D Hardness value of 80. Samples shall be allowed to cure at room temperature, 75 ± 2 °F for a minimum of 72 hours and a maximum of 168 hours prior to performing the indicated test.

(k) *Abrasion Resistance.* The abrasion resistance shall be evaluated on Taber Abrader with a 1000 gramload and CS-17 wheels. The duration of the test shall be 1000 cycles. The wear index shall be calculated based on ASTM test method C-501 and the wear index for the catalyzed material shall not be more than 80. The tests shall be run on cured samples of material which have been applied at film thickness of 15 ± ½ mils to code S-16 stainless steel plates. The samples shall be allowed to cure at 75 ± 2 °F for a minimum of 72 hours prior to performing the indicated tests.

(l) *Tensile Strength.* When tested according to ASTM D 638, the epoxy pavement marking materials shall have a tensile strength of not less than 6000 psi. The Type IV Specimens shall be cast in a suitable mold and pulled at the rate of ¼ inch per minute by a suitable dynamic testing machine. The samples shall be allowed to cure at room temperature (75 ± 2 °F) for a minimum of 72 hours and a maximum of 168 hours prior to performing the indicated tests.

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REVISION OF SECTIONS 106, 627 AND 713
EPOXY PAVEMENT MARKING

(m) *Compressive Strength.* When tested according to ASTM D 695, the catalyzed epoxy pavement marking materials shall have a compressive strength of not less than 12,000 psi. The cast sample shall be conditioned at room temperature, 75 ± 2 °F, for a minimum of 72 hours and a maximum of 168 hours prior to performing the tests. The rate of compression of these samples shall be no more than ¼ inch per minute.

REVISION OF SECTION 202
REMOVAL OF TRAFFIC SIGNAL EQUIPMENT

Section 202 of the Standard Specification is hereby revised for this project as follows: Subsection 202.03 shall include the following:

The Contractor shall safeguard any salvageable materials designated by Denver Traffic, and shall be responsible for the expense of repairing or replacing damaged or missing material until it is delivered to the City and County of Denver Traffic Maintenance Yard at 5440 Roslyn Street.

Designation of salvageable equipment and times for delivery of such items shall be coordinated with Denver Traffic (contact Chris Lillie at 720-865-4066 or Greg Salazar at 303-591-7146).

Signal operations shall be maintained at each of the project intersections throughout construction.

Subsection 202.04 shall include the following:

Removal of the traffic signal equipment shall include signal poles (without luminaries), pedestal poles, footings, span wire cable, traffic signal controller and cabinet, pedestrian push button, cabinet footings, all attachment hardware, and all incidental equipment, except as noted on plans. All existing foundations and pull boxes shall be removed and back-filled. All wiring shall be removed from existing conduit and the conduit shall be abandoned in place.

Xcel Energy shall remove all signal poles with luminaries attached. Xcel Energy will remove only the signal pole and luminaries, and the Contractor shall remove the remainder of the traffic signal equipment, as noted in the plans. The Contractor shall coordinate with Xcel Energy for these removals and is referred to the Project Special Revision “Utilities” herein.

All “Light Emitting Diode” (LED) signal lenses in existing signal faces shall be removed prior to the removal of the signal face. These LED lenses shall be protected from damage and delivered to 5440 Roslyn Street, Denver. This work shall be included in the cost of Removal of Traffic Signal Equipment and will not be paid for separately.

Times for delivery to the maintenance yard shall be coordinated with Denver Traffic Engineering Services at (720) 865-4000.

REVISION OF SECTION 613
ELECTRICAL CONDUIT CCD LATERALS– GENERAL

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

Add the following to subsection 613.07:

Directional boring is the preferred method of conduit installation.

All conduit bends, including factory-installed bends, shall not have a bend radius less than six times the inside diameter of the conduit.

The excavations required for the installation of conduit or cable shall be performed in such a manner as to avoid unnecessary damage to streets, sidewalks, landscaping, sprinkler systems and other improvements. Trenches shall not be excavated wider than necessary for the installation of the electrical appurtenances. Excavation shall not be performed until immediately before installation of conduits. The material from the excavation shall be placed in a position not to cause damage or obstruction to vehicular or pedestrian traffic or interfere with surface drainage.

Trenches shall be made with a rock-wheel or other machine capable of cutting a narrow trench (4") so as to allow traffic to pass over prior to back filling. The machine shall be equipped with shields to direct the spoil downward and away from passing vehicles, workmen and pedestrians.

Off-street trenches shall be back-filled with the same material that was removed and shall be compacted and shaped to match the surrounding surface. On-street trenches within ALL roadway areas shall be back-filled with CDOT approved Structure Backfill (Flow-Fill) and capped with 9" minimum of Hot Mix Asphalt Pavement (Patching) in accordance with Section 403 and City and County of Denver Street Cut Regulations if applicable. If surrounding pavement depth is greater than 9 inches, the HMA (Patching) depth shall match the existing pavement.

All surface materials including sprinkler systems, landscaping, shrubs, sod grass, and native growth vegetation which is disturbed by trenching and back-filling operation shall be restored in kind equal to or exceeding the original conditions.

All conduit runs that will not have a copper conductor installed shall have a #14 AWG stranded copper conductor placed inside for locating purposes. Locating conductor and tape will not be measured and paid separately, but shall be included in the unit price for conduit.

Conduit shall always enter a pull box, hand-hole, or any other type structure from the direction of the run only.

All conduit shall be fully compatible with fiber optic cable. Plastic conduit shall be Schedule 80 in the diameters shown on the plans. Each conduit shall be equipped with a pull tape and each bore shall have a copper tracer wire of at least 14 gauge.

Each conduit shall be equipped with either a pull rope or pull tape, depending on the length of conduit between pull boxes.

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REVISION OF SECTION 613
ELECTRICAL CONDUIT CCD LATERALS – GENERAL

Each conduit with a length greater than 400' between pull boxes, shall be equipped with a pull tape. The pull tape shall have a minimum tensile strength of 1250 lbs. and be of a design and manufacture that prevents cutting or burning into the conduit during cable installation.

Each conduit with a length of 400' or less between pull boxes shall be equipped with a pull rope or pull tape. The pull rope shall have a minimum tensile strength of 1250 lbs.

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

If the contractor is unable to jack or bore the conduit at the lengths shown on the plans from pull box to pull box, all splice couplings and associated work to splice the conduit shall be included in the cost of this item. This shall include excavation down to the required depth of conduit at the splice location. Also included in the cost of this item are all landscape repairs, which will be required after excavation of conduit at all splice locations. All splice couplings shall be water and air tight and installed at a depth to match the remaining run of conduit. No elevation difference will be allowed. Splices shall be kept to a minimum and all locations shall be approved by the City. Additional pull boxes shall not be substituted for splices.

All conduit bends, including factory-installed bends, shall not have a bend radius less than six times the inside diameter of the conduit.

Conduit plugs for sealing conduit shall also be supplied and installed in all open conduit ends as soon as the conduit is installed. Plugs shall be durable, fabricated from no metallic parts, be of the split design to allow removal and reinstallation around in-place cables and be easily removable and reusable. Plugs shall be capable of being installed by hand without any tools and shall provide a water and air tight seal of at least 100 psi and shall cause no damage to the cable when installed.

At some locations (as illustrated on the Plans or in these specifications, or as directed by the Engineer), new conduits shall be installed in an existing pull box. At these locations, the Contractor shall carefully excavate around the pull box and install the new conduit in the pull box in a manner that meets the requirements of this Special Provision. The Contractor shall not damage the existing pull box. If the existing pull boxes or concrete collars are cracked or damaged during conduit installation, the Contractor shall be required to replace either or both conforming to the requirements of the contract at no additional cost.

Subsection 613.10 shall include the following:

Electrical Conduit will be measured by the linear feet of conduit and installed in accordance with these Special Provisions, the Project Standards or as directed by the City. Electrical Conduit will include groundwork, sweeps, pull cord, copper tracer wire, adapters, fittings, splice couplings, conduit plugs (for conduits both with and without fiber optic cable), equipment, labor, and all other items necessary to complete the work.

REVISION OF SECTION 613
PULL BOXES – GENERAL

Section 613 of the Standard Specifications is hereby revised for this project as follows: Subsection 613.07 shall include the following:

Pull boxes Type A and Type B shall be used in all signal conduit installation. Pull boxes shall be made of fiberglass reinforced polymer concrete designed to support a minimum service load of

20,000 pounds over a 10 inch by 10 inch square. The pull box shall have a detachable cover with a skid-resistant surface and have the words "TRAFFIC" or, "ELECTRIC" cast into the surface. Painting the words shall not be accepted. The cover shall be attached to the pull box body by means of screw-in bolts and shall have two lift slots to aid in the removal of the lid. Non-standard bolts shall not be used.

All traffic communication pull boxes shall have the words "TRAFFIC COMM" physically impressed (not painted) on its top. The interconnect pull boxes or Pull Box (Special) shall be the Type C pull box. The covers shall be attached to the pull box body by screw-in bolts and shall have two lift slots to aid in the removal of the lid.

All concrete collars, footings, and location marker supports shall be Portland Cement Concrete Class B and shall be in accordance with Section 601.

Pull boxes that are to be in traveled ways shall be outfitted with traffic bearing lids rated for HS 20-44 loads. The pull boxes shall have a special concrete footing extending 8 inches around the outside and 6 inches around the inside of the pull box bottom, as shown in the plans. Pull boxes installed in dirt or landscape areas shall have a 12 inch wide by 6 inch thick concrete collar placed around the top in lieu of the concrete footing, as shown in the plans.

When the plans call for a fiber optic cable location marker to be installed at the pull box location, the concrete foundation support for the location marker shall be placed monolithically with the concrete collar.

Pull Box (Surface Mounted) shall be metal type with a hinged front door and have at least a NEMA 3R rating. The hinged door shall be provided with both a weather tight seal and a key lock mechanism. Surface mounted pull boxes shall be of the dimensions shown in the plans, and shall be mounted on or embedded into hard surfaces such as bridge decks, concrete barriers, retaining walls, or buildings, as shown on the plans. Surface mounted pull boxes shall be attached using 3/8-inch epoxy anchors or other methods, as approved by the Engineer. Surface mounted pull boxes shall not be used for ground installations.

Subsection 613.11 shall include the following:

Pull Boxes Type A and Type B will not be measured or paid for separately but shall be included in the cost of conduit.

REVISION OF SECTION 613
LIGHTING

Section 613 of the Standard Specifications is hereby revised for this project as follows: Subsection 613.02 shall include the following:

Highway lighting materials and equipment for installation and modifications shall be compatible or interchangeable with standard materials and equipment as stocked by XCEL.

Lighting materials and equipment that are compatible with that stocked by XCEL are as follows:
Curvilinear Luminaries on City and County of Denver traffic poles:

Manufacturer	Catalog Numbers
Gardco	CA2213120250HPSFGPPC1069 Mast Arm Fitter
Kim Lighting	CCS25A3/250HPS 120/FG-P/A-
25MAF Sterner	FTA25A103HP250S120NS-RF2

Contractor shall submit a lighting materials list to XCEL for approval prior to ordering (Steve Smith, at 303-571-3945).

Subsection 613.08 shall include the following:

At least one grounding electrode shall be installed adjacent to each light standard. Wiring shall be a 120/240 volt or 120/208 volt, 3-wire system with individual luminaries wired for 120 volts.

REVISION OF SECTION 613
ELECTRICAL METER PEDESTAL CABINET AND BASE

Section 613 of the Standard Specifications is hereby revised for this project as follows: Subsection 613.07 shall include the following:

New traffic signal installations require an electric meter pedestal cabinet and base for the traffic signal. The electrical meter shall be furnished by XCEL. The Contractor shall furnish and install the electric meter cabinet and pedestal base at the locations as show on the plan and in accordance with the City and County of Denver's standard. The cost of the meter base is paid for separately.

Subsection 613.10 shall include the following:

Electric Meter Pedestal Cabinet and Base will be measured and installed in accordance with these Special Provisions, the Project Standards or as directed by the City. The Electric Meter Pedestal Cabinet and Base installation will include groundwork, sweeps, pull cord, copper tracer wire, adapters, fittings, splice couplings, conduit plugs, equipment, labor, and all other items necessary to complete the work.

REVISION OF SECTION 614
CONCRETE FOOTING (TRAFFIC SIGNAL POLE)

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.08 shall include the following:

(m) Traffic Signal Pole Footings: Concrete foundations for all traffic signal poles and traffic signal-light poles shall conform to City and County of Denver Signal Standards and Details Latest Revision.

Subsection 614.10 (e) shall include the following:

Installation of concrete signal pole footings shall conform to the requirements of Section 503.

In Subsection 614.13, delete the second sentence and replace with the following:

Precast foundations used for traffic signal light poles without mast arm will not be measured or paid for separately but shall be included in the cost of the traffic signal light poles (no mast arm).

Drilled caissons used as foundations for traffic signal poles with mast arm will be measured by the number of individual footings installed complete in place and paid for as Concrete Footing (Traffic Signal Pole).

REVISION OF SECTION 614
LED PEDESTRIAN SIGNAL HEAD (COUNTDOWN)

Section 614 of the Standard Specifications is hereby revised for this project as follows: Subsection 614.01 shall include the following:

This work includes the installation of LED Pedestrian Signal Faces with countdown timers as shown in the Contract.

Subsection 614.08 (h) shall include the following:

Pedestrian signal faces with countdown timers shall meet the following requirements:

(1) The dimensions of the signal housing and the LED symbols, as well as moisture and dust resistance requirements shall be in accordance with the current ITE PTCSI Standards.

(2) Signal housing shall be aluminum, painted in Federal Green and "clam-shell" mounted. (3) The signal shall have user-selectable modes for countdown for walk cycle only, pedestrian cycle only, or both walk and pedestrian clearance.

(4) The countdown module shall have an internal conflict monitor to prevent any possible conflicts between the Hand/Person signal indications and the time display. The display shall not countdown during a Solid Hand indication.

(5) LED symbols shall be solid icons and shall provide uniform light dispersion such that the "pixel" effect is minimized. Lettered or outline symbol styles will not be permitted. (6) The Man/Hand configuration shall provide clear and distinct lamination where either symbol is in use.

(7) The LED module shall be rated for use in an ambient operating temperature range of -40° F to 165° F.

(8) The signal shall meet NEMA Standard TS2 for voltage surge protection, and shall have an automatic reset in case of a power outage.

Subsection 614.13 shall include the following:

LED Pedestrian Signal Face (Countdown) will be measured by the actual number of units that are installed and accepted.

REVISION OF SECTION OF 614
TRAFFIC CONTROL DEVICES

Section 614 of the Standard Specification is hereby revised for this project as follows: Subsection 614.08 (h) shall include the following:

> "Light Emitting Diode" (LED) signal lenses shall be installed in all Red, Yellow, Green, Walk and Don't Walk, and Countdown signal displays. This work shall be included in the cost of the item for Traffic Signal Face and will not be paid for separately.

REVISION OF SECTION 614
TRAFFIC SIGNAL CONTROLLER CABINET

Section 614 of the Standard Specifications is hereby revised for this project as follows: Subsection 614.01 shall include the following:

This work shall consist of furnishing and installing a new P-type Traffic Controller Cabinet and complete installation of the Traffic Signal Controller Cabinet assembly, malfunction management units (MMU), vehicle detector amplifiers, uninterrupted power supply (UPS), other ancillary hardware, and traffic signal cabinet base per City and County of Denver standards.

Delete Subsection 614.08 (c) and replace with the following:

> All new cabinets are the P-type cabinets as per the City & County of Denver Traffic Standards. Each cabinet shall be installed on a newly installed traffic signal controller cabinet base unless otherwise specified on the plan. Contact Chris Lillie at 720-865-0466 for cabinet assembly requirements and all other necessary auxiliary hardware.
>
> Controller cabinet assemblies shall include an integrated uninterrupted power supply (UPS) units that comply with the City and County of Denver standards (see UPS spec).

Subsection 614.10 shall include the following:

The Contractor shall demonstrate successful traffic signal operations at all new controller and cabinet locations to the satisfaction of the Engineer or Engineer's designee prior to acceptance of this item. The Contractor shall contact the Engineer or Engineer's designee 3 days before turning on signal. Work shall include all required programming of controllers and establishing or re- establishing all required wiring connections. Phasing and timing information at each location shall be furnished to the Contractor by the City & County of Denver.

All new wiring shall conform to City & County of Denver and International Municipal Signal Association (IMSA) specifications.

Subsection 614.13 shall include the following:

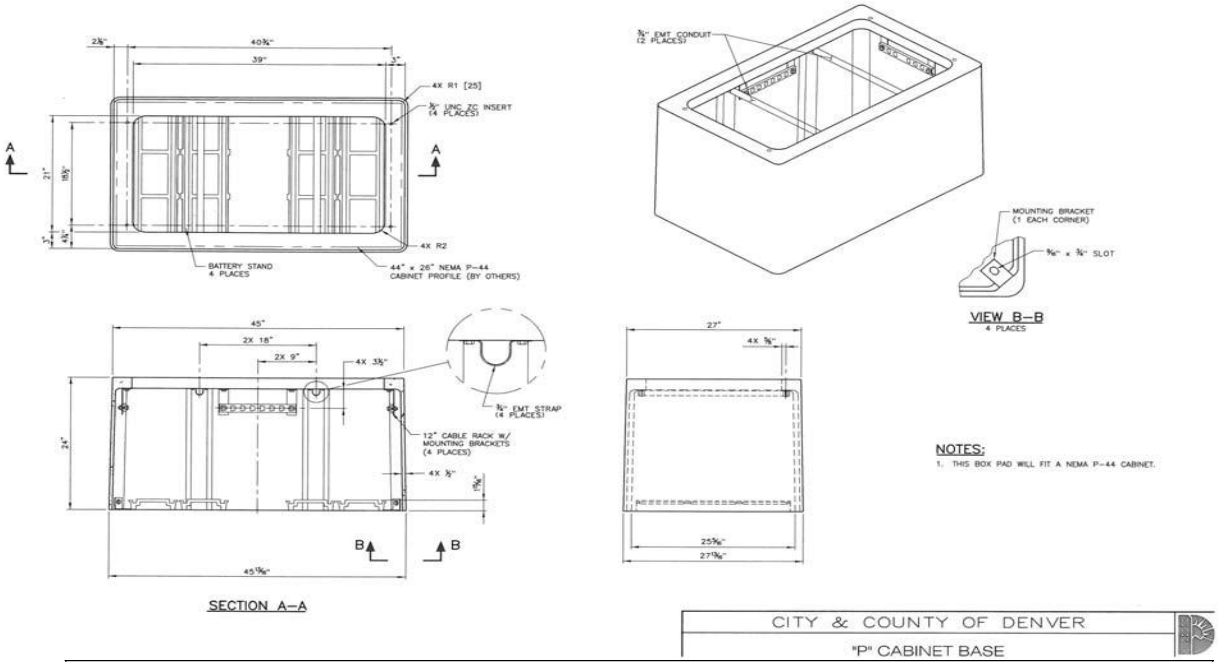
The unit price for the installation of traffic signal controllers cabinets shall include all labor, materials, ancillary hardware, traffic signal cabinet base, wiring and wiring re-connection (including Xcel Energy power feed) required to provide successful operation of the item.

REVISION OF SECTION 614
TRAFFIC SIGNAL CABINET BASE

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

This work consists of furnishing and installing a Quazite Traffic Signal Controller Cabinet Base as shown on the plans and in accordance with the City & County of Denver standards. The base shall fit the City and County of Denver's P-Type Traffic Signal Controller Cabinet. Dimensions of the base are shown in the following drawing.



Subsection 614.10 shall include the following:

Prior to starting cabinet base installation, the contractor shall obtain field verification of the location of the base from the Engineer or Engineer's designee.

Cabinet base installation shall include all labor and materials to completely install a new P-type cabinet base for the controller cabinet as specified in the plans. This is to include all conduit installation and modification work, back-filling, and repair to all surrounding surface/area.

Subsection 614.13 shall include the following:

The traffic signal cabinet base and installation will not be measured and paid for separately, but shall be incidental to the Traffic Signal Controller and Cabinet installation.

REVISION OF SECTION OF 614
PEDESTRIAN PUSH BUTTON AND INSTRUCTION SIGN

Section 614 of the Standard Specification is hereby revised for this project as follows:

Subsection 614.08 (f) shall include the following:

1. Push button assemblies shall be of the direct push button solid state contact type and shall not have any levers, handles or toggle switches externally or internally. The pushbutton shall be of tamperproof and all weather construction. The pushbutton shall have a protective shroud that is an integral part of the cover and it shall encircle the pushbutton actuator to deter vandalism. The assembly shall be made weatherproof and shockproof by means of synthetic rubber gaskets between the cover and the enclosure and between the plunger and the cover so that it shall be impossible to receive an electrical shock under any weather conditions. The front cover plate shall be secured with stainless steel vandal resistant screws. The push button shall operate on logic ground.

2. The solid state switch shall be entirely insulated from the housing and operating button. The pushbutton shall consist of a 2 inch 303 stainless steel metal plunger and an oil and gasoline resistant Piezo driven solid state switch, all encased in a high impact thermoplastic enclosure with four (4) stainless steel mounting screws. The solid state switch shall be normally open and shall be closed with a minimum of pressure on the button (3lb ± 1lb), restoring immediately to the normally open position when the pressure is released.

   The aluminum housing shall be the flat back frame type with adjustable mounting staves that will readily enable it to be mounted on any size traffic signal pole or push button standard. The housing shall have a ½ inch access hole in the rear for wiring. The housing shall have a bottom threaded conduit entrance hole and shall be provided with a threaded plug so that access is only possible from the rear of the housing. The plug shall not be removable with ordinary tools. The housing shall be painted Dark Olive/Federal Green baked enamel matching to Federal Standard 595A color #14056.

   The frame shall have a cast aluminum attachment to allow the mounting of a 9” X 12” pedestrian instruction sign. By removal of 4 screws the frame shall convert to allow the mounting of a 5” X 7 ¾” pedestrian instruction sign.

Pedestrian Instruction Sign.

1. Pedestrian instruction signs shall conform to the latest version of the M.U.T.C.D., published by the U.S. Department of Transportation Federal Highway Administration.

2. Pedestrian instruction signs shall be Type R10-3a, Type R10-3b, Type R10-3c, R10-3d, and R10-3e as specified in the contract documents (or bid documents).

   Pedestrian instruction signs shall be constructed in accordance with the applicable provisions of the current CCD Standard Specifications. Pedestrian instruction sign need not be reflectorized.

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PEDESTRIAN PUSH BUTTON AND INSTRUCTION SIGN

The sign shall be fabricated with 0.063 aluminum. The signs shall be mounted using four 5/16" mounting holes 4" X 6 ¾" for the 5" X 7 ¾" sign and 7" X 10" for the 9" x 12" sign. The pedestrian instruction signs shall have rounded corners ¾" radius for the 5" X 7 ¾" sign and 1 ½" radius for the 9" X 12" sign.

REVISION OF SECTION 614
INTERSECTION DETECTION SYSTEM (CAMERA)

Section 614 of the Standard Specifications is hereby revised for this project as follows: Subsection 614.01 shall include the following:

This work consists of furnishing and installing a fully-functional video detection system at the intersection as specified on the plans.

Subsection 614.08 shall include the following:

System Hardware:

The machine vision system hardware shall consist of three components: 1) a color, 22x zoom, MVP sensor; 2) a modular cabinet interface unit; 3) a communication interface panel. Additionally, an optional personal computer (PC) shall host the server and client applications that are used to program and monitor the system components. The real-time performance shall be observed by viewing the video output from the sensor with overlaid flashing detectors to indicate the current detection state (on/off). The MVP sensor shall optionally store cumulative traffic statistics internally in non-volatile memory for later retrieval and analysis.

The MVP shall communicate to the modular cabinet interface unit via the communications interface panel and the software applications using the industry standard TCP/IP network protocol. The MVP shall have a built-in, Ethernet-ready, Internet Protocol (IP) address and shall be addressable with no plug in devices or converters required. The MVP shall provide standard MPEG-4 streaming digital video. Achievable frame rates shall vary from 5 to 30 frames/sec as a function of video quality and available bandwidth.

The modular cabinet interface unit shall communicate directly with up to eight (8) MVP sensors and shall comply with the form factor and electrical characteristics to plug directly into a NEMA type C or D detector rack providing up to thirty-two (32) inputs and sixty-four (64) outputs or a 170 input file rack providing up to sixteen (16) contact closure inputs and twenty-four (24) contact closure outputs to a traffic signal controller.

The communication interface panel shall provide four (4) sets of three (3) electrical terminations for three-wire power cables for up to eight (8) MVP sensors that may be mounted on a pole or mast arm with a traffic signal cabinet or junction box. The communication interface panel shall provide high-energy transient protection to electrically protect the modular cabinet interface unit and connected MVP sensors. The communications interface panel shall provide single-point Ethernet connectivity via RJ45 connector for communication to and between the modular cabinet interface module and the MVP sensors.

System Software:

The MVP sensor embedded software shall incorporate multiple applications that perform a variety of diagnostic, installation, fault tolerant operations, data communications, digital video streaming, and vehicle detection processing. The detection shall be reliable, consistent, and perform under all weather, lighting, and traffic congestion levels. An embedded web server shall permit standard internet browsers to connect and perform basic configuration, maintenance, and video streaming services.

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REVISION OF SECTION 614
INTERSECTION DETECTION SYSTEM (CAMERA)

There shall be a suite of client applications that reside on the host client / server PC. The applications shall execute under Microsoft Windows XP or 7. Available client applications shall include:

- Master network browser: Learn a network of connected modular cabinet interface units and MVP sensors, display basic information, and launch applications software to perform operations within that system of sensors.
- Configuration setup: Create and modify detector configurations to be executed on the MVP sensor and the modular cabinet interface unit.
- Operation log: Retrieve, display, and save field hardware run-time operation logs of special events that have occurred.
- Software install: Reconfigure one or more MVP sensors with a newer release of embedded system software.
- Streaming video player: Play and record streaming video with flashing detector overlay.
- Data retrieval: Fetch once or poll for traffic data and alarms and store on PC storage media.
- Communications server: Provide fault-tolerant, real-time TCP/IP communications to / from all devices and client applications with full logging capability for systems integration.

MVP Sensor:

The MVP sensor shall be an integrated imaging color CCD array with zoom lens optics, high- speed, dual-core image processing hardware bundled into a sealed enclosure. The CCD array shall be directly controlled by the dual-core processor, thus providing high-quality video for detection that has virtually no noise to degrade detection performance. It shall be possible to zoom the lens as required for setup and operation. It shall provide JPEG video compression as well as standard MPEG-4 digital streaming video with flashing detector overlay. The MVP shall provide direct real-time iris and shutter speed control. The MVP image sensor shall be equipped with an integrated 22x zoom lens that can be changed using either configuration computer software. The digital streaming video output and all data communications shall be transmitted over the three-wire power cable.

Power: The MVP sensor shall operate on 110/220 VAC, 50/60Hz at a maximum of 25 watts. The camera and processor electronics shall consume a maximum of 10 watts and the remaining 15 watts shall support an enclosure heater.

Detection Zone Programming: Placement of detection zones shall be by means of a PC with a Windows XP or 7 operating system, a keyboard, and a mouse. The PC monitor shall be able to show the detection zones superimposed on images of traffic scenes.

The detection zones shall be created by using a mouse to draw detection zones on the PC monitor. Using the mouse and keyboard it shall be possible to place, size, and orient detection zones to provide optimal road coverage for vehicle detection. It shall be possible to download detector configurations from the PC to the MVP sensor and cabinet interface module, to retrieve the detector configuration that

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INTERSECTION DETECTION SYSTEM (CAMERA)

is currently running in the MVP sensor, and to back up detector configurations by saving them to the PC fixed disks or other removable storage media.

The supervisor computer's mouse and keyboard shall be used to edit previously defined detector configurations to permit adjustment of the detection zone size and placement, to add detectors for additional traffic applications, or to reprogram the MVP sensor for different traffic applications or changes in installation site geometry or traffic rerouting.

Optimal Detection: The video detection system shall optimally detect vehicle passage and presence when the MVP sensor is mounted 30 feet (10 m) or higher above the roadway, when the image sensor is adjacent to the desired coverage area, and when the distance to the farthest detection zone locations are not greater than ten (10) times the mounting height of the MVP. The recommended deployment geometry for optimal detection also requires that there be an unobstructed view of each traveled lane where detection is required. Although optimal detection may be obtained when the MVP is mounted directly above the traveled lanes, the MVP shall not be required to be directly over the roadway. The MVP shall be able to view either approaching or receding traffic or both in the same field of view. The preferred MVP sensor orientation shall be to view approaching traffic since there are more high contrast features on vehicles as viewed from the front rather than the rear. The MVP sensor placed at a mounting height that minimizes vehicle image occlusion shall be able to simultaneously monitor a maximum of six (6) traffic lanes when mounted at the road-side or up to eight (8) traffic lanes when mounted in the center with four lanes on each side.

Count Detection Performance: Using an installed camera that meets the optimal viewing specifications described above for count station traffic applications, the system will be able to accurately count vehicles with at least 98% accuracy under normal operating conditions (day and night), and at least 93% accuracy under artifact conditions.

Artifact conditions are combinations of weather and lighting conditions that result from shadows, fog, rain, snow, etc. The volume count will be accumulated for the entire roadway (all traveled lanes), and accumulated over time intervals that contain a minimum of ne hundred (100) vehicles to ensure statistical significance.

Demand Presence Detection Performance: Using an installed camera that meets the optimal viewing specifications described above for intersection control traffic applications, the system will be able to accurately provide demand presence detection.

The demand presence accuracy will be based on the ability to enable a protected turning movement on an intersection stop line, when a demand exists. The probability of not detecting a vehicle for demand presence will be less than 1% error under all operating conditions. In the presence of artifact conditions, the MVP will minimize extraneous (false) protected movement calls to less than 7%.

To ensure statistical significance, the demand presence accuracy and error will be calculated over time intervals that contain a minimum of one hundred, protected turning movements.

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INTERSECTION DETECTION SYSTEM (CAMERA)

These performance specifications will be achieved with a minimum of 2 presence detectors coupled with a single detector function (Type-9) to provide adequate road coverage to sample the random arrival pattern of vehicles at the stop line.

The calculation of the demand presence error will not include turning movements where vehicles do not pass through the presence detectors, or where they stop short or stop beyond the combined detection zones.

Speed Detection Performance: The MVP will accurately measure average (arithmetic mean) speed of multiple vehicles with more than 97% accuracy under all operating conditions for approaching and receding traffic.

The average speed measurement will include a minimum of 100 vehicles in the sample to ensure statistical significance. Optimal speed detection performance requires the camera location to follow the specifications described above for count station traffic applications with the exception that the camera must be higher than 13 m (40) feet.

The MVP will accurately measure individual vehicle speeds with more than 94% accuracy under all operating conditions for vehicles approaching the camera (viewing the front end of vehicles), and more than 90% accuracy for vehicles receding from the camera (viewing the rear end of vehicles).

These specifications will apply to vehicles that travel through both the count and speed detector pair and will not include partial detection situations created by lane-changing maneuvers.

To ensure statistical significance, the average speed accuracy and error will be calculated over time intervals that contain a minimum of one hundred vehicles.

Using a MVP sensor installed within the optimal viewing specifications described above or count station traffic applications

Modular Cabinet Interface Unit:

The modular cabinet interface unit shall provide the hardware and software means for up to eight (8) MVP sensors to communicate real-time detection states and alarms to a local traffic signal controller. It shall comply with the electrical and protocol specifications of the detector rack standards. The card shall have 1500 Vrms isolation between rack logic ground and street wiring.

The modular cabinet interface unit shall be a simple interface card that plugs directly into a 170 input file rack or a NEMA type C or D detector rack. The modular cabinet interface unit shall occupy only 2 slots of the detector rack. The modular cabinet interface unit shall accept up to sixteen (16) phase inputs and shall provide up to twenty-four (24) detector outputs.

Communications Interface Panel:

The communications interface panel shall support up to eight MVPs. The communications interface panel shall accept 110/220 VAC, 50/60 Hz power and provide predefined wire termination blocks for MVP power connections, a Broadband-over-Power-Line (BPL) transceiver to support up to 10MB/s

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INTERSECTION DETECTION SYSTEM (CAMERA)

interdevice communications, electrical surge protectors to isolate the modular cabinet interface unit and MVP sensors, and an interface connector to cable directly to the modular cabinet interface unit.

The interface panel shall provide power for up to eight (8) MVP sensors, taking local line voltage 110/220 VAC, 50/60 Hz and producing 110/220 VAC, 50/60 Hz, at about 30 watts to each MVP sensor. Two ½-amp SLO-BLO fuses shall protect the communications interface panel.

System Installation & Training:

The supplier of the video detection system may supervise the installation and testing of the video detection system and computer equipment as required by the contracting agency. Training is available to personnel of the contracting agency in the operation, set up, and maintenance of the video detection system. The MVP sensor and its support hardware / software is a sophisticated leading-edge technology system. Proper instruction from certified instructors is recommended to ensure that the end user has complete competency in system operation. The User's Guide is not an adequate substitute for practical classroom training and formal certification by an approved agency.

Warranty, Service, & Support:

For a minimum of three (3) years, the supplier shall warrant the video detection system. An option for additional year(s) warranty for up to 6 years shall be available. Ongoing software support by the supplier shall include software updates of the MVP sensor, modular cabinet interface unit, and supervisor computer applications.

These updates shall be provided free of charge during the warranty period. The supplier shall maintain a program for technical support and software updates following expiration of the warranty period. This program shall be available to the contracting agency in the form of a separate agreement for continuing support.

Subsection 614.13 shall include the following:

Intersection Detection System (Camera) shall be measured and paid by the number of intersections at which the system is installed. The item shall include all labor, materials, and ancillary hardware required to provide a fully-functional system to the satisfaction of the Engineer.

REVISION OF SECTION 614
EMERGENCY VEHICLE TRAFFIC SIGNAL PRIORITY CONTROL SYSTEM

Section 614 of the Standard Specifications is hereby revised for this project as follows: Subsection 614.08 shall include the following:

System Description:

The emergency vehicle traffic signal priority control system shall enable designated vehicles to remotely cause the traffic signal controller to advance to and/or hold a desired traffic signal display by using existing controller functions. The control shall be activated at a minimum distance of 548.6M (1,800 feet) along an unobstructed "line of sight" path. The control shall not terminate until the vehicle is within 12.2M (40 feet) of the detector or at the intersection.

The system shall consist of the following components:

(a) Vehicle Emitter which shall be mounted on the emergency vehicle and shall transmit optical energy signals only in the forward direction. If the municipality presently uses optical pre-emption, the emitters shall be of the same manufacture currently used by the City and County of Denver Fire Department.

(b) Phase Selector (minimum 2 channels) which shall cause the signal controller to advance to and/or hold the desired traffic signal display for the emergency vehicle. A pre-emption system chassis shall house two phase selectors.

(c) Optical Detector which shall be mounted on or near a traffic signal and shall receive the optical energy signals generated by the Vehicle Emitter.

1. Detector (Type A), 1 Direction, 1 Channel

2. Detector (Type B), 2 Direction, 1 Channel

3. Detector (Type C), 2 Direction, 2 Channel

(d) Detector Cable (Optical).

System Operations:

(a) The operating sequence shall be initiated when the optical detector receives the required optical energy signal from the Emitter.

(b) The phase selector shall cause the traffic signal controller to advance to and/or hold the desired traffic signal display for the emergency vehicle.

(c) The phase selector shall cause the controller to advance to and/or hold the desired traffic signal display even if the optical energy signals cease before the desired display is obtained.

(d) The phase selector shall allow the traffic signal controller to resume normal operation within ten seconds after optical energy signals cease if the optical energy signals cease after the desired traffic signal display is obtained.

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EMERGENCY VEHICLE TRAFFIC SIGNAL PRIORITY CONTROL SYSTEM

(e) The phase selector shall not respond to optical energy signals from an emergency vehicle if it is already processing optical energy signals from another emergency vehicle.

System Components:

(a) *Vehicle Emitter*.

The emitter assembly consists of an emitter and power supply and an emitter control switch assembly. The emitter assembly is mounted on a vehicle and produces a flashing optical signal when in operation. The following shall apply to the vehicle emitter:

1. Shall operate on ten to fifteen volts DC input voltage, but shall not be damaged by input voltage surges up to twenty-five volts DC.

2. Shall be controlled by a single on/off switch that requires no other adjustments by the operator. The on/off condition shall be indicated by a light located adjacent to the switch.

3. Shall be automatically disabled or de-activated by one or a combination of the following: seat switch, emergency brake switch, door switch, and transmission safety switch.

4. Shall operate over an ambient temperature range of minus 34O C to plus 60O C. (minus 30O F. to plus 140O F.)

5. Shall operate in 0 to 95 % humidity.

6. Shall be a pulsed optical energy source with a controlled repetition rate.

7. Shall not generate voltage transients on the battery input line which exceed battery voltage by more than four volts.

8. Shall produce optical energy in a cone of not more than 90 degrees horizontal and not more than 30 degrees vertical. The detectors and/or phase selector shall not sense a pre-emption signal from an emitter outside this cone.

(b) *Optical Detector*.

The optical detector receives the high intensity optical pulses produced by the emitter. These optical energy pulses are transformed by the detector into appropriate electrical signals which are transmitted to the phase selector. The optical detector is mounted at or near the intersection in a location which permits an unobstructed line of sight to vehicular approaches. The units may be mounted on signal span wires, mast arms or other appropriate structures. The following shall apply to the optical detector:

1. Shall produce optical energy in a cone of not more than 90 degrees horizontal and not more than 30 degrees vertical. The detectors and/or phase selector shall not sense a pre-emption signal from an emitter outside this cone.

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EMERGENCY VEHICLE TRAFFIC SIGNAL PRIORITY CONTROL SYSTEM

2. Shall be of solid state construction.

3. Shall operate over an ambient temperature range of minus 34O C to plus 60O C. (minus 30O F. to plus 140O F.)

4. Shall have internal circuitry potted in a semi-flexible compound to ensure moisture resistance.

5. Shall operate in 0 to 95 % humidity.

6. Shall have a cone of detection of not more than 13 degrees. The detector and/or phase selector shall not sense a pre-emption signal from an emitter outside this cone.

(c) *Phase Selector.*

The phase selector supplies power to and receives electrical signals from the optical detector. When detector signals are recognized as a valid call, the phase selector causes the signal controller to advance to and/or hold the desired traffic signal display. This is accomplished by activating the pre-empt input to the controller.

The phase selector is capable of assigning priority traffic movement to one of two channels on a first-come, first-serve basis. Each channel is connected to select a particular traffic movement from those normally available within the controller. Once a call is recognized, "commit to green" circuitry in the phase selector functions so that the desired green indication will be obtained even if optical communication is lost. After serving a priority traffic demand, the phase selector will release the controller to follow normal sequence operation. The following shall apply to the phase selector:

1. Shall include an internal power supply to supply power to the optical detectors.

2. Shall have minimum two-channel operation with the capability of interfacing with an additional phase selector for expansion of channels of operation.

3. Shall have adjustable detector range controls for each channel of operation, from 12M (40 feet) to 548M (1800 feet).

4. Shall have solid state indicator lights for power on and channel called.

5. Shall operate over an ambient temperature range of minus 34O C to plus 60O C (minus 30O F. to plus 140O F.)

6. Shall operate in 0 to 95 % humidity.

(d) *Detector Cable (Optical).*

The following shall apply to the detector cable:

1. 3-Conductor cable with shield and ground wire.

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2. AWG #20 (7x28) stranded.

3. Individually tinned copper strands.

4. Conductor insulation: 600 volt, 75 deg. C (167O F.).

5. 1 Conductor-yellow; 1 Conductor-blue; 1 Conductor-orange.

6. Aluminized Mylar shield tape or equivalent.

7. AWG #20 (7x28) stranded uninsulated drain wire

8. DC resistance not to exceed 11.0 ohms per 305M (1000 feet).

9. Capacitance from one conductor to other two conductors and shield not to exceed 157pf/M (48pf /ft.).

10. Jacket: 600 volts, 80 deg. C (176O F.), minimum average wall thickness -1.14mm (.045").

11. Finished O.D.: 7.62mm (0.3") max.

System Interface:

System shall be capable of operating in a computerized traffic management system when appropriate interfacing is provided by the computer supplier.

General:

The Contractor shall furnish the manufacturer the phasing diagrams indicating controller sequence and timing.

The Contractor shall secure from the manufacturer a guarantee for the equipment for a period of sixty (60) months, which time shall commence from the date of delivery. Manufacturer shall certify upon request that all materials furnished will conform to this specification. The manufacturer or his designated representative shall be responsible for determining and setting all required range and emitter intensity for the emergency vehicle operation.

Construction Methods:

All equipment except the vehicle emitter assembly shall be installed and wired in a neat and orderly manner in conformance with the manufacturers' instructions. The vehicle emitter assembly shall be delivered to a designated City representative.

Installation of the vehicle emitter assembly shall be the responsibility of the City and County of Denver Fire Department.

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EMERGENCY VEHICLE TRAFFIC SIGNAL PRIORITY CONTROL SYSTEM

Traffic signals owned and maintained by the State that have optical pre-emption equipment owned and maintained by the town shall have an Auxiliary Equipment Cabinet (AEC) attached to the controller cabinet. The optical pre-emption equipment shall be housed in the AEC. Traffic signals owned and maintained by the town do not require an AEC to house the pre- emption equipment.

Detector cables shall be continuous with no splices between the optical detector and the AEC. Detector locations shown on the plan are for illustration purposes only. Exact location shall be determined by the contractor or the designated representative for the best possible line of sight.

If not present in an existing traffic controller cabinet, the following items shall be installed and connected, in conformance with the current Functional Specifications for Traffic Control Equipment, "D" Cabinet Requirements (Pre-emption Type):

- Controller "D" harness and adapter.
- Pre-emption termination panel with terminal block and relay bases.
- Pre-emption disconnect switch, mounted on the emergency switch panel (on inside of cabinet door).
- Pre-emption test buttons, mounted on the pre-emption termination panel.

All connections from the phase selector to the "D" harness and to the cabinet wiring shall be made at the termination panel. The termination panel shall have AC+ Lights, AC-, and a switched logic ground. The switched logic ground feeds all the pre-empt inputs to the phase selector. When switched off by the pre-emption disconnect switch, the traffic controller shall not be affected by pre-empt calls from the optical pre-emption system. A minimum of two test buttons shall be provided. If there are more than two pre-empt runs, a button for each shall be installed. A chart or print out indicating the program steps and settings shall be provided along with the revised cabinet wiring diagrams.

Test the Pre-emption System According to the following Guidelines:

1. Notify the system owner/user, such as the Municipal Fire Chief or City Traffic Engineer, of the scheduled inspection

2. Request a fire department representative and an emergency vehicle, which has an emitter to conduct the test. If not available, the contractor shall provide an emitter.

3. In the presence of the Engineer and the municipal representative, test each pre- empted approach with the emergency vehicle. Test the following items of the system:

    - Confirm that the emitter activates the phase selector and the phase selector activates the correct pre-emption input to the controller.
    - Confirm adequate range. The traffic signal must be pre-empted to green sufficiently in advance of the emergency vehicle arrival. The vehicle emitter shall initiate pre-emption at a minimum distance of 548.6M (1800 feet).

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EMERGENCY VEHICLE TRAFFIC SIGNAL PRIORITY CONTROL SYSTEM

- Confirm there are no false calls. Keep the emitter active as the emergency vehicle passes through the intersection. No other optical detectors shall sense the strobe.

4. Document the test. Provide the Engineer and, upon request, the municipality copies of the test results.

If a malfunction is found or the system needs adjustment (such as range, emitter intensity, or detector location), schedule a follow-up test. Repeat the above steps for all approaches that did not pass.

All adjustments such as emitter intensity, phase selector range, sensitivity, detector placement, shall be made at the intersection by the contractor so that the optical pre-emption operates correctly with other major manufacturers' equipment currently owned by the town.

Subsection 614.13 shall include the following:

Emergency Vehicle Traffic Signal Priority Control System units shall include a four-channel card and the number of detectors as shown on the plans. Emergency Vehicle Traffic Signal Priority Control System shall be measured and paid by the number of intersections at which the system is installed. The item shall include all labor, materials, and ancillary hardware required to provide a fully functioning system to the satisfaction of the Engineer.

REVISION OF SECTION 614
TRAFFIC SIGNAL POLES – GENERAL

Section 614 of the Standard Specifications is hereby revised for this project as follows: Subsection 614.08 (g) shall include the following:

Traffic Signal Poles. All traffic signal poles and mast arms shall conform to City and County of Denver Standards and the local utility company's (Xcel Energy) requirements. The traffic signal pole standards are shown below:

All traffic signal poles shall include a 10 foot long luminaries mast arm and a 250 WATT high pressure sodium curvilinear style luminaries in accordance with the current City and County of Denver Standards. Prior to order of traffic signal poles, mast arms and luminaries, contractor shall submit material specifications to the City and County of Denver Traffic Engineering Services for approval.

All traffic signal mast arm poles and mast arms shall be powder coated in accordance with the following specifications:

General.

Super Durable Powder Coating: The super durable powder coating shall consist of a Urethane or Triglycidyl Isocyanurate (TGIC) Polyester Powder, and provide a minimum of 3 times the gloss retention, color retention and ultraviolet light (UV) resistance as standard powder coatings. Color shall be dark olive green, in conformance with Federal Specification No. 14056.

Surface Preparation.

The exterior steel surface shall be blast cleaned to Steel Structures Painting Council Surface Preparation Specification No. 6 (SSPC-SP6) requirements utilizing cast steel abrasives conforming to the Society of Automotive Engineers (SAE) Recommended Practice J827. The blast method is a recirculating, closed cycle centrifugal wheel system with abrasive conforming to SAE Shot Number S280.

The exterior and interior surfaces of the pole shafts shall be hot dip galvanized from the base end for a length of approximately 12.0'.

Interior Color.

Interior surfaces (pole shafts only) at the base end for a length of approximately 2.0' shall be mechanically cleaned and coated with a zinc rich epoxy powder. The coating shall be electrostatically applied and cured in a gas fired convection oven by heating the steel substrate to a minimum of 350 degrees Fahrenheit and a maximum of 400 degrees Fahrenheit.

Exterior Coating.

All exterior surfaces shall be coated with Urethane or Triglycidyl Isocyanurate (TGIC) Polyester Powder to a minimum film thickness of 2.0 mils (0.002"). The coating shall be electrostatically applied and cured in a gas fired convection oven by heating the steel substrate to a minimum of

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TRAFFIC SIGNAL POLES – GENERAL

350 degrees Fahrenheit and a maximum of 400 degrees Fahrenheit. The thermosetting powder resin shall provide both intercoat as well as substrate fusion adhesion that meets 5A or 5B classifications of ASTM D3359.

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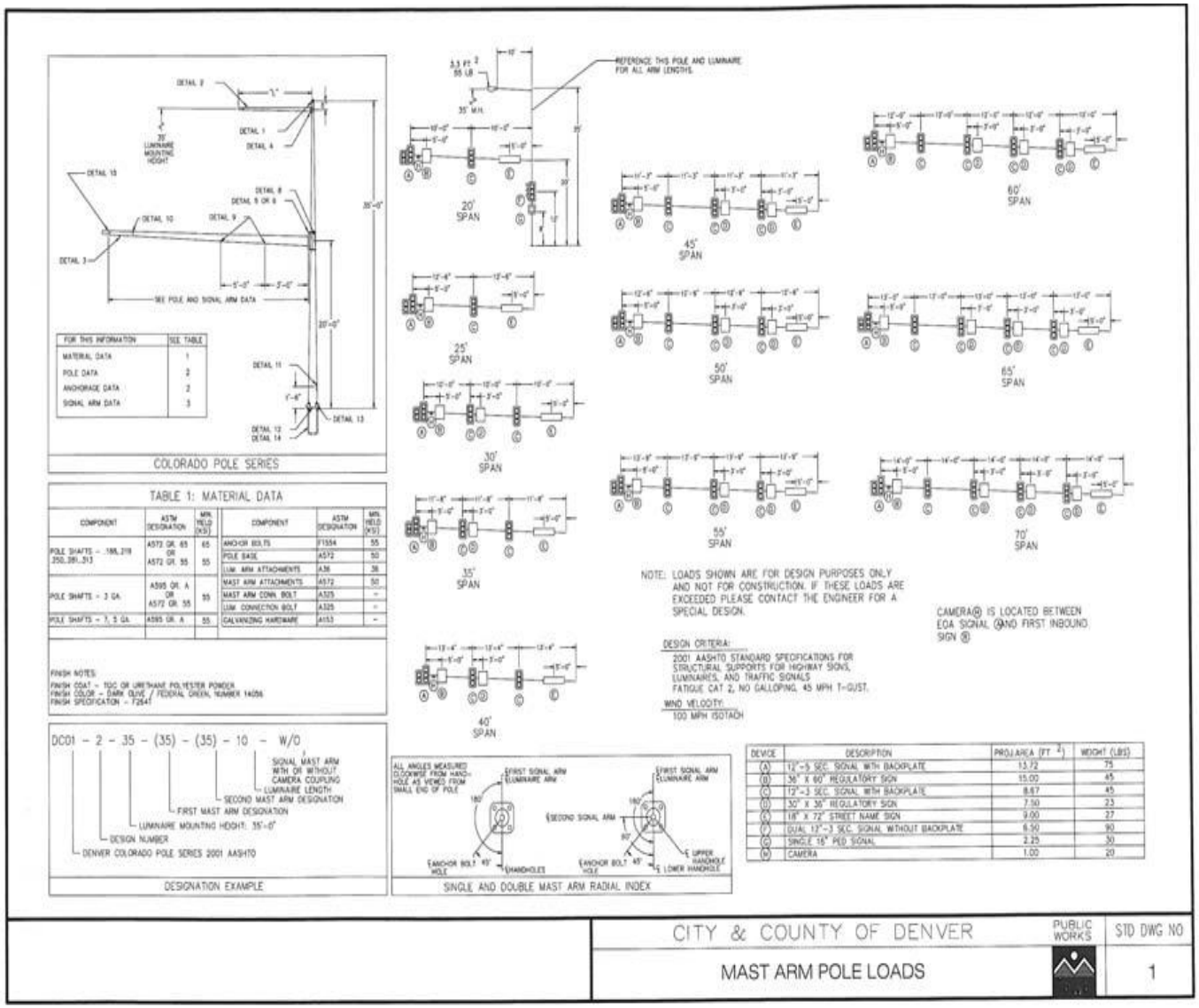
TRAFFIC SIGNAL POLES – GENERAL



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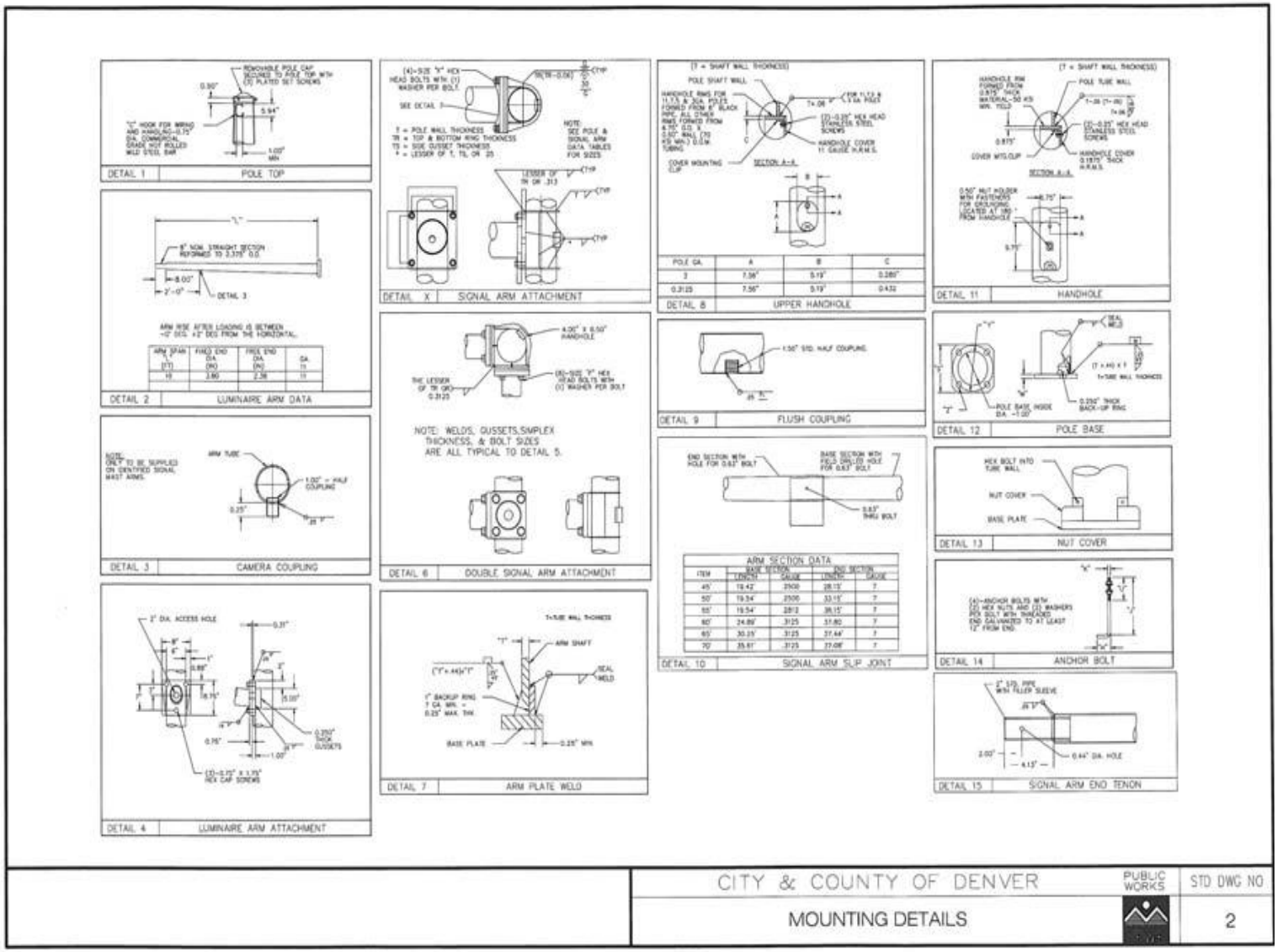

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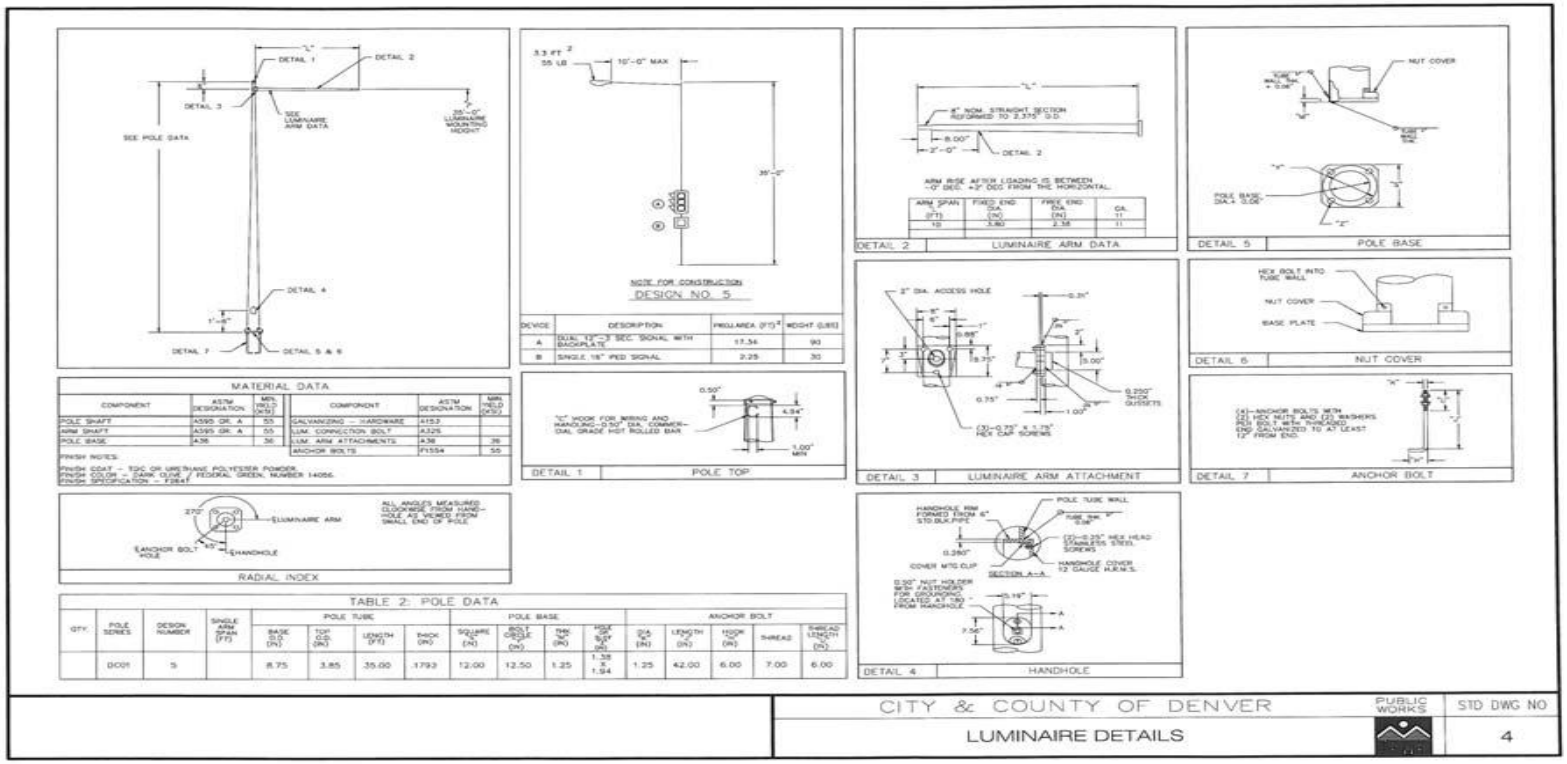
TRAFFIC SIGNAL POLES – GENERAL



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TRAFFIC SIGNAL POLES – GENERAL

TABLE 2: POLE DATA

POLE SERIES	DESIGN NUMBER	SINGLE ARM SPAN (FT)	DOUBLE MAST ARMS		POLE TUBE				POLE BASE				ANCHOR BOLT			
			1st ARM SPAN (FT)	2nd ARM SPAN (FT)	BASE O.D. (IN)	TOP O.D. (IN)	LENGTH (FT)	THICK (IN)	SQUARE "B" (IN)	BOLT CIRCLE "C" (IN)	THK "M" (IN)	HOLE DIA. SLOT "N" (IN)	DIA "K" (IN)	LENGTH "J" (IN)	HOOK "H" (IN)	THREAD LENGTH "G" (IN)
DC01	1	20,25,30,35, & 40	N.A.	N.A.	15.50	10.60	35.00	.1875	21.00	20.00	1.75	2.00	1.75	84.00	6.00	8.00
DC01	2	45,50 & 55	N.A.	N.A.	17.00	12.10	35.00	.2188	23.00	22.00	2.00	2.25	2.00	84.00	6.00	10.00
DC01	3	60,65, & 70	N.A.	N.A.	19.50	14.60	35.00	.2500	26.00	25.00	2.00	2.25	2.00	84.00	6.00	10.00
DC01	4	N.A.	20 THRU 40	20 THRU 40	15.50	10.60	35.00	2500	23.00	22.00	2.00	2.25	2.00	84.00	6.00	10.00

MAXIMUM ARM LENGTH COMBINATION FOR DUAL CONFIGURATION ARE 40'-0"/40'-0". ARM LENGTHS EXCEEDING THESE WILL REQUIRE A SPECIAL POLE DESIGN.

TABLE 3: SIGNAL ARM DATA

SIGNAL ARM TUBE				SIGNAL ARM SIMPLEX					
MAXIMUM ARM SPAN (FT)	FIXED END DIA. (IN)	SMALL END DIA. (IN)	GAUGE	A X B (IN)	C X D (IN)	THICKNESS "E" (IN)	BOLT SIZE "F" (IN)	GUSSET THICKNESS (IN)	ANGLE OF RISE IN ARM
20.00	9.00	6.20	7	21.75 X 21.75	18.00 X 18.00	1.75	1.50 X 3.75	.375	0.00°
25.00	10.00	6.50	7	21.75 X 21.75	18.00 X 18.00	1.75	1.50 X 3.75	.375	0.50°
30.00	12.00	7.80	5	21.75 X 21.75	18.00 X 18.00	1.75	1.50 X 3.75	.375	0.50°
35.00	12.50	7.60	5	21.75 X 21.75	18.00 X 18.00	1.75	1.50 X 3.75	.375	1.00°
40.00	13.00	6.90	3	21.75 X 21.75	18.00 X 18.00	1.75	1.50 X 3.75	.375	1.50°
45.00	14.00	8.06	SEE DETAIL 10	23.25 X 23.25	19.50 X 19.50	2.00	1.50 X 4.25	.500	1.50°
50.00	15.00	8.36	SEE DETAIL 10	23.25 X 23.25	19.50 X 19.50	2.00	1.50 X 4.25	.500	1.50°
55.00	15.00	7.66	SEE DETAIL 10	23.25 X 23.25	19.50 X 19.50	2.00	1.50 X 4.25	.500	2.00°
60.00	15.75	7.71	SEE DETAIL 10	26.25 X 26.25	22.50 X 22.50	2.00	1.50 X 4.25	.500	2.00°
65.00	16.50	7.76	SEE DETAIL 10	26.25 X 26.25	22.50 X 22.50	2.00	1.50 X 4.25	.500	2.00°
70.00	17.25	7.81	SEE DETAIL 10	26.25 X 26.25	22.50 X 22.50	2.00	1.50 X 4.25	.500	2.50°

CITY & COUNTY OF DENVER — PUBLIC WORKS

TABLE DATA

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REVISION OF SECTION 614
TRAFFIC SIGNAL POLES – GENERAL

Packaging.

Prior to shipment, small poles shall be wrapped in 0.188" thick Ultraviolet inhibiting plastic backed foam. Larger poles shall be cradled in a 1.0" rubberized foam base.

Handling and Shipment.

Poles shall be handled in a manner that will preserve the overall appearance and prevent damage to the coating. The use of chains or cables for loading, unloading, or installing is prohibited. Only ¾ inch diameter or larger nonabrasive nylon rope or equivalent nylon belting will be used. Adequate hold-downs and appropriate blocking shall be utilized for shipping to prevent load movement and damage to the outer coating in transit. No handling should be allowed until "dry through" condition has been achieved with the coating.

Delivery, Installation, and Acceptance of Poles.

Extra care will be taken not to damage the coating. Upon arrival of the poles at the delivery point, neither chains nor cables will be used to either unloading or installation of poles.

Procedure for Field Touch-Up.

The pole manufacturer will furnish extra paint, both primer and color coat, to satisfy the needs of field touch-up requirements, in the event of minor physical damage to the coating from handling or transit. Damaged area must be clean and dry before repair application. Field touch-up will be at the direction of the pole manufacturer or their authorized representative.

REVISION OF SECTION 614
TRAFFIC SIGNAL CONTROLLER (SOLID STATE)
(FULL-ACTUATED) (12 PHASE)

Section 614 of the Standard Specifications is hereby revised for this project as follows: Delete Subsection 614.08 (b), and replace with the following:

Traffic Signal Controllers – General

This specification sets forth the minimum requirements for a shelf-mountable, two through twelve phases, fully-actuated, digital, solid-state traffic controller. The controller shall meet, as a minimum, all applicable sections of the NEMA Standards Publication No. TS2-1998. Where differences occur, this specification shall govern. Controller versions shall be available to comply with NEMA TS2"Types 1 and 2. Type 2 versions of the controller shall be capable of operating as a Type 1.

The controller shall meet or exceed the specifications of the Econolite model ASC/3-1000 Fully Actuated Controller (http://www.econolite.com/docs/controller_asc3_specification.pdf), or an equivalent approved by the City and County of Denver Traffic Engineering Services.

Subsection 614.09 shall include the following:

The Contractor shall deliver the traffic signal controller, and cabinet assemblies and other auxiliary hardware, to the City and County of Denver Traffic Operations Center at 5440 Roslyn Street, Building E, Denver, Colorado 80216 six (6) weeks before installation for controller programming. The Contractor shall coordinate the pick-up of the controller and cabinet assembly from the City and County of Denver's Traffic Engineering Services and shall install it at the proper location. The Contractor shall coordinate pick-up times with Chris Lillie at (720) 865-4066.

The controller shall be installed in accordance with the details shown in the plans and in accordance with manufacturer's recommendations.

Subsection 614.13 shall include the following:

Traffic Signal Controller (Solid State) (Full Actuated) (12 phase) shall include pedestrian detectors and all auxiliary equipment required on the plans and shall include all work necessary to provide and install a complete system. Connection of the controller to the fiber optic interconnect system shall be paid for separately under item 614 "Telemetry (Field)".

REVISION OF SECTION 614
RAMP METERING CONTROLLER

Section 614 of the Standard Specifications is hereby revised for this project as follows:

In subsection 614.08, delete (b) and (c) and replace with the following:

(b) *Ramp Metering Controllers – General.* Each controller shall be a Type 170E-HC11 with 4 ACIA connectors and 2 modem slots per FHWA-IP-78-16 specifications except as noted below.

Each controller shall be fully warranted for materials and workmanship for a period of one year from date of receipt.

In addition to the manual (as specified in the FHWA-IP-78-16 specifications), two "D" size (24" x 34.5") drawings of all schematics and assembly prints contained in the manual shall be supplied for each twenty controllers or revisions change.

The 170E-HC11 Controller shall come with a blank panel covering the Prom Module opening.

The front panel of the 170E-HC11 shall have a DB-9 connector. This connector shall be in parallel with the C40 connector to allow the operator to attach a laptop to interface with the controller instead of connecting to the C2

All Integrated circuits having more than 14 pins shall be socket mounted on all boards including the front panel, CPU board, Input board, and Output board. Sockets shall have machined beryllium copper contacts with gold plating.

Each controller shall be supplied with diagnostic software on a 32K EPROM. No additional program chip shall be required to set any bit or flag when changing from the Traffic program used by CDOT to the diagnostic program.

The internal EEPROM feature of the 68HC11F1 shall be disabled.

The FHWA-IP-78-16 specification's Vendor's Testing Certification shall be modified to read "The Vendor shall supply with each shipment a full test report of the quality control and final test conducted on each item." In addition, the Contractor shall supply a statement with each 170E-HC11 controller that the unit was tested in accordance with Section 1.8.5.3.3 as modified below.

Section 1.8.5.3.3 shall be modified to read "A minimum 100-hour burn-in of all modules is required. This burn-in shall include 48 hours of monitored testing at the high and low temperatures as described in 1.8.3.7.1 and 1.8.3.7.2."

1. *HC11 CPU Board.* The HC11 based CPU Module shall operate a 68HC11F1 MPU with a crystal operating frequency of 8 MHz. The MPU chip shall be socket mounted in an AMP PLCC socket #82147-1 series HPT or equal.

   The 6850 communication ICs shall be used and shall operate with a crystal frequency of 6.144 MHz. There shall be four 6850 chips with the programmable jumpers to select 5 different communication baud rates per chip (1200, 2400, 4800, 9600, and 19,200) for a total

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REVISION OF SECTION 614
RAMP METERING CONTROLLER

of 20 jumpers. There shall be no IRQ inhibits provided and all ACIA's shall be active. Programs should be written to initialize the four communications chips upon startup. An IRQ status register shall be provided as defined in the 170E CALTRANS specification.

The EPROM and RAM shall be resident on the CPU board, and shall be socket mounted. The EPROM socket shall be a 32-pin ZIF force Device. The Ram socket shall be a 28 pin Augat 828 series or equal.

RAM will be continuous from locations $0000 to $6FFF. RAM shall be a ZERO power device exclusively, and be a Dallas 1230 or equal.

When an optional RTC clock is required, the RAM shall be a Dallas 1644 or equal. (Clock address shall be in the I/O map at location $7FF8 to $7FFF).

A jumper select shall be provided to switch locations $6000 to $6FFF from Internal to External for access to the remote Dual Port location. The status of the jumper position shall be read on the IRQ register-bit five.

When an enhanced Program Module is used with this system, it shall only have access to addresses 600/6FF for dual port.

The Prom chip shall be either a 32K x 8 or a 128K x 8 device, and be jumper selectable.

When using a 128K EPROM, a bank switch shall be enabled within the EPROM memory system. This bank switch shall function by moving to the upper 64K segment of the EPROM. The bank switch jumper controls address line A16. The bank shall be activated by a write to location $7002 (directly connected to Port G on HC-11 MPU), which will cause memory to go to the upper 64K of the 128K EPROM. This will enable an extra 32K of EPROM memory via bank switching. The status of A16 shall read on the IRQ status register-bit six.

Feature and location switches shall be provided on the front portion of the CPU board. Each switch shall be an eight-position front reading dipswitch. These switches shall be decoded as follows:

Features switch shall be addressed at $700A – Port E

Location Switches shall be addressed at $7000 – Port A

A header shall be provided near the front of the module for the SPI and serial interface pins.

There shall be one LED indicator located on the front of the CPU board that shall be controlled via a software output of Port G bit 3.

The +12VDC, +5VDC and +/-12VDC voltages input in the CPU board shall have transorb protection.

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REVISION OF SECTION 614
RAMP METERING CONTROLLER

The system address organization of the HC-11 Module shall consist of two addressing configurations. The decoder shall be furnished in address 1.

The two addressing configurations shall be selectable by use of a three-post jumper. The following input line state conditions shall cause the Decoder to provide the associated address configuration. The jumper shall be labeled "INT" and "EXT".

Each CPU board shall be furnished with an EPROM Chip with the controller diagnostic program installed. No additional program chip shall be required to set any bit or flag when changing from the Traffic program used by CDOT and the diagnostic program.

All integrated circuits having more than 14 pins shall be socket mounted. Sockets shall have machined beryllium copper contacts with gold plating.

I Controller Cabinets. The controller cabinet shall be Model 334. Each cabinet shall be natural aluminum with anchor bolts in accordance with the FHWA-IP-78-16 specification. The input files shall meet the requirements of the split input file below. Unless otherwise specified in the Contract, the cabinet shall include the following:

Quantity	**Item**
1 ea	170E-HC11
2 ea	Internal (1 per door) fluorescent lamps
2 ea	Model 430 Transfer Relays
1 ea	PDA-3 with Model 206 24 VDC power supply
2 ea	Model 204 2-circuit Flasher (cube type, 25 AMP output)
3 ea	Model 200 Load Switch (cube type, 25 AMP output with I/O indications)
1 ea	208 Watchdog Monitor
1 ea	New York 330 Pull-out Drawer Assembly
1 ea	Transient Voltage Surge Suppression
1 ea	Split Input File
1 ea	Standard Output file with terminal strips
1 ea	PDA Power Supply

Each cabinet shall have two doors and Corbin #2 Locks.

The cabinet shall have a powder coating base TCI WHEEL SILVER #9811-0110 Polyester TGIC Powder Coating and top coating shall be TCI ANTI GRAFFITI Power paint applied at a thickness of 2.4 mils.

The cabinet shall have a hinged protective shield over the Circuit Breakers to prevent them from being accidentally turned off. The hinged shield shall be mounted in such a way that the switches are still readily visible to the technician and can be easily turned on or off.

Split Input file. The split input file shall be an SF 170, which will operate in the standard 332/336 cabinets. The Split Input File shall use the same form factors as the present (older) input file and shall be completely interchangeable with these older input files except as follows. The input file

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REVISION OF SECTION 614
RAMP METERING CONTROLLER

shall use a split 22-pin connector (2 rows or 22 pins) which provide for 44 unique contacts, rather than the 22 double contacts as provided by the former input file.

This design shall interface electrically with the older 2 and 4 channel devices available under the 170 and NEMA TS1 specification as will as the newer 2 and 4 channel devices as specified in the TS2 NEMA specification.

The input file shall be divided into two partitions. The first partition shall include the first eight slots from the left; the second partition shall include the next six slots.

The serial/TTL Transmit and receive pairs shall be wired across the back panel. TXO, DXO, and Ground0 serve the first eight slots; TX1, DX1 and Ground1 serve the next six slots. Back plane addressing is automatically assigned in the rear of the input file, such that Slot 1 – Address 0, Slot 2 – Address 1 . . . Slot 8 = Address 7(all three lines low)

Addressing from the front of any input device shall override the back plane addressing.

Serial connections shall use a standard quick lock connection.

Transient Voltage Surge Suppression System. Transient Voltage Surge Suppression (Surge Protection) shall be a solid-state device with a maximum surge current capacity of 6500 peak current amps x 1 @ 8 X 20 microsecond wave.

The unit shall be UL recognized, both 1449 and 508. The enclosure is to be rated as a NEMA 1 and resistant to oil, moisture, dust and other airborne contaminants.

The units shall be fused (no thermo fusing allowed). Components shall be suitably spaced and have a sub-nanosecond response time (potting compound is not allowed). The Surge Protection is to be suitable for continuous line voltage of a maximum of 130 volts. Nominal clamping voltage shall be no more than 200 volts.

Unit shall have a failure indicator and alarm suitable for RTU connection.

The Operating temperature shall be -40^{o}C to +70^{o}C EMI-RFI noise attenuation to 40 dB. Capacitance shall be 1 to 1.5 microfarad per line.

Neutral to ground/phase to ground connection is not allowed. The Unit shall be modularly designed for quick replacement with no tools needed.

The Unit shall be mounted no more than 8 inches from the incoming power termination point and terminated in parallel with the incoming power.

The Manufacturer must have a satisfactory performance record with this specific device for a minimum of five years.

All of the above components provided, excluding the signal monitor unit, shall be on the CDOT Approved Products list.

REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.08 shall include the following:

The double conversion uninterrupted power supply system (UPS) shall provide emergency battery power to the traffic signal controller. The work consists of furnishing and installing an UPS in accordance with the City and County of Denver's standards and shall conform to the following specifications:

Operation.

The UPS system shall be capable of producing a fully regenerated, conditioned, pure sine wave AC. The online operational mode shall be continuous to all loads. It shall incorporate a high frequency Pulse-Width Modulated technology and shall use an input rectifier, charger, battery and inverter in a single board configuration. The UPS double conversion UPS shall provide a clean, pure AC sine-wave output at all times with a voltage input variation of 85VAC to 145VAC while providing 120VAC to the connected load at all times. The UPS shall be capable of operating in the voltage range of 85VAC to 135VAC without using the batteries and always provide a regulated output to the protected loads.

The Input rectifier shall be rated at 2.5 times the output rating of the inverter.

The Inverter circuit shall be in continuous operation at all times (constant duty). The inverter shall be rated for 100% duty cycle and simultaneously fed from the rectifier and battery to eliminate any switching to battery or transitions during power fluctuations or power interruption. The inverter's output shall be pure clean sine wave with an efficiency of up to 85%.

The constant duty operation shall be rated in total watts. This will enable the traffic UPS to support any combination of signal heads whether Incandescent, LED or Neon, by any manufacturer, regardless of power-factor.

The UPS shall be capable of operating from a generator source without the need for over-sizing the UPS system. During operation from a generator source, the UPS shall operate in a normal fashion and provide filtered and regulated power with or without automatic input/output frequency synchronization. Upon excessive generator frequency drift, the UPS shall compensate through regeneration and supplying both continuous frequency and voltage regulation to the protected load.

The UPS shall be capable of glitch ride through capabilities and provide a seamless output to the connected load during this anomaly without the use of the batteries.

The UPS shall be capable of providing an overload output rating of 120% for 60 seconds, 150% for 10 seconds to any combinations of signal types whether Incandescent, LED or Neon during inrush or overload conditions.

The UPS shall have an internal static bypass that will transfer to line power if over load exceeds 150% for more than 5 sec. This bypass will maintain the load until this overload has cleared.

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REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

The UPS shall have a separate Neutral detecting circuit that shall monitor loss of utility neutral and completely disconnect any input source to the UPS system.

The UPS shall have an input back feed relay operating in series with the Neutral monitoring circuit.

Upon loss of utility power, the UPS inverter shall continue to provide seamless pure sine-wave AC from the batteries without switching, transfer or changing its' operating status. The UPS will use the battery mode in '0' ms. This will insure that the UPS provides pure sine wave power under all conditions, at all times without interruption.

The UPS will continue to provide generated AC from the inverter until the batteries are depleted. When the batteries have been depleted, the UPS will ensure upon the return of Utility Power that the UPS will restart automatically and provide regenerated AC to the protected equipment and allow the equipment to resume normal operation.

The UPS shall be capable of operating in a full regenerated, power-conditioning mode with depleted batteries or failed batteries. The regenerative power conditioning will ensure that there will be regulated and conditioned pure AC power to the equipment. This regenerative mode will provide extended brown-output protection with wide input line regulation, noise filtering and surge protection.

The UPS shall operate in an uninterruptible regenerative on-line mode during flash or normal signal operation.

The UPS shall be rated at Unity Power Factor. The output VA and Watts rating shall be equal on the output at all times.

The UPS shall be capable of COLD starting without AC present and provide AC power to the load.

The UPS shall be capable of self diagnostics during start up or with the use of the front panel TEST button.

The UPS case shall be constructed from .064 aluminum and carbon steel.

The UPS input and output connections shall be Anderson Power Pole quick lock connector to eliminate exposed terminals or connections.

The UPS to bypass interconnect harness shall be reversible with matching Anderson Power connectors that will prevent risk of shock, or damage to the connected equipment.

The UPS shall be capable of Hot-Swapping the batteries or battery bank, without shutting down the UPS.

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REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

The UPS shall be capable of being Hot-Swapped during normal operation when used with the external Hot Swap Bypass. The UPS may also be shut-off with the Hot Swap Bypass in place without loss of AC to the loads.

The UPS shall be capable or providing a replaceable relay card with relay output contacts for AC fail, Inverter ON, Low Battery, Battery Fail, Bypass and Alarms.

The UPS relay card may be replaced with an SNMP card for SNMP communications and information.

The UPS shall provide a programmable Dry Relay output for flash.

The contacts shall be provided in N/O and N/C positions. The delay timer shall be a maximum of 10 hours.

The timer shall be front panel mounted.

The Timer dial shall be 4.7 inches in circumference.

The timer shall have a scale in increments of 1s to 10seconds. This scale can be changed to indicate 1 minute, to 10 minutes or a maximum scale of 1 hour to 10 hours.

The scale shall be controlled by two (2) separate dip switches on the timer face.

The timer shall indicate using a flashing RED LED that the timing function is operating.
The timer shall use a steady RED LED to indicate that the timing is now completed

The timer shall count in a down mode to ‘0’ from the preset time indicated on the scale.

The LED indicators shall provide status for AC line, UPS Battery Mode, Charging, Low Battery, Fault, Bypass, Percentage of Load and Battery Charge.

The Event counter and Hour meter may be rest to ‘0’ using separated buttons.

The UPS shall have a battery changer rated at 200 watts @ 36VDC with an optional of 400 watts.

This charger shall be completely separate from the rectifier/inverter included with the main UPS board.

The UPS chargers may be used in a parallel configuration for increased charger ratings.

The UPS uses a redundant internal 1 amp charger that will continue to charger the batteries if the separate board charger fails.

The UPS may be used with redundancy in mind with the use of the Dual Hot Swap Option. That will provide a secondary UPS source in less than 20ms. The Secondary UPS may be connected to the alternate input of the Hot Swap Bypass.

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REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

The Flash programming shall be a simple and field programmable without the use an external connected device such as a laptop or computer.

The Hot swap Bypass shall allow the UPS to be removed or installed at any time during normal load operation.

The UPS shall include standard graphical real time software and connection cable.

The UPS shall be capable of sending programmable system alarms to the Econolite "icons" Traffic Management System.

Physical Description.

The UPS shall consist of 3 major components. The Main board Rectifier/Inverter, charger and control board.

The Main Board shall consist of a True-Sine-Wave constant duty high frequency inverter utilizing High-Frequency Pulse-Width Modulated technology.

The Input Rectifier shall be rated for the total wattage output rating of the UPS including the

150% overload and the charger rating. The inverter shall be a high efficiency constant duty design with and efficiency of 83%. The inverter shall include its' own static bypass which provides an alternate AC path during overload and or Inverter alarm conditions.

The heat-sink shall be a continuous aluminum extrusion design with plenum directed airflow cooling. The 12VDC dual stage cooling fans shall be variable speed controlled by the logic board.

The charger portion shall be a 3 stage Hysterisis .5 amp, 36 or 72VDC charger with temperature compensation. The supplementary charger, is a parallel design rated for 200, 500 and 1000 watts.

The Electronic Control board shall monitor the Rectifier and Inverter functions. It shall also provide the overall control of all the UPS functions and or operational capabilities.

Mounting Configuration.

The UPS shall be shelf mounted or rack mounted per the documents. Shelves and cabinets shall be supplied by others. Where rack mounting is required, the 170 style mounting method shall be

19" rack mount. Rack mounting ears shall be removable.

A separate stand alone NEMA Traffic cabinet may be supplied if required in the plans and specifications.

4 rubber feet shall be installed on the bottom of the unit for shelf mounting.

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REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

Battery System.

The batteries shall be comprised of a quantity of three (3), high temperature, deep cycle (45AH) batteries which have been proven under extreme temperature conditions. The battery system or configuration shall consist of one string. Each string shall be 36 VDC. The batteries shall be provided with the appropriate interconnect cables. The battery cables shall have a minimum conductor size rating of #10.

The battery cable shall consist of a quick release Anderson connector rated at 25 amps. For the purpose of safety, the connector shall have recessed pins and keyed interlock to prevent reversal of connection or separation.

Battery construction shall be of a polycarbonate high temperature design combined with high, pure lead content with internal resistance of.0028 ohms and a high impact poly case construction, to with stand high vibration and shock. The connections shall be of stainless steel 3/8 stud, with 3/8 stainless nut and locking washer. Removable lifting handle shall be standard.

The batteries shall also meet the following characteristics:

Nominal voltage:	12VDC Capacity@ 25C: 45AH Approx weight: 13.5Kg Internal Resistance: 9.5 mOhms
Dimensions:	197mm x 165mm x 170mm (7.76 x 6.50 x 6.69)
Capacity (10hr rate):	75c-112% 65c-108% 55c-105% 25c-100% 0c- 85% -15c- 65%
Self Discharge:	3 months 91% capacity remaining 6 months 82% capacity remaining 12 months 65% capacity remaining
Operating Temperature:	-15c to +75C Float Voltage: 13.5 to 13.80
Cyclic charging voltage:	14.5 to 14.90
Maximum charge current:	12A Terminal material: Copper
Maximum discharge current:	400A (5 sec)

The system must be 36 volt DC maximum (no exception).

Electrical Specifications.

The unit shall meet the following electrical specifications:

Design:	Double Conversion true on line.
Nominal input:	110, 115 & 120v AC single phase dip switch selectable.
Input Voltage Range:	80v to 140v AC
Input frequency:	50/60hz (47 to 63)

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REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

Efficiency:	83 %
Input configuration:	3 wire with ground
Input Protection:	15 amp re-settable breaker (on UPS 700) Input
Current:	10.4 amps (includes charger) (on UPS 700)
Power Rating Continuous:	700 watts, 1400watts, 2100 watts
Output Current:	@ 700 watts 5.8 amps / 11.6 @1400/ 17.7@2100
Output regulation:	+/- 3% with 100% resistive load
Output regulation w/low battery:	+/- 3% with 100% resistive load
Output Voltage:	120v AC
Output Wave Form:	Pure sine wave
Harmonic Distortion:	3% Linear Load; 5% Non Linear Load
Dynamic Response:	+/- 5% RMS for 100% step load change 1 ms recovery time
Overload Capability:	120% for 60 sec 150% watts for 10 sec
Charger:	200 watt 36VDC UPS 700, 72VDC on UPS 1400 Parallel 400, 1000 and 2000 watt.
Surge:	ANSI-C62.41
Fault Clearing:	Current Limit and automatic to bypass
Short Circuit protection:	Output Breaker / Fuse, then shut down
Load Power Factor:	6 leading to .6 lagging
Output Connection:	Anderson Power Pole Connector 6 pin keyed. DC
Connection:	Anderson 50 amp Keyed Recessed connector
Recognition:	UL Recognized & IEE 587 / C62.41 on main UPS board
Mechanical:	

The UPS shall meet the following physical dimensions: For 700 W UPS:

Size:	6.00” H x 10.5” D x 15.15” W
Weight:	18 lbs

The enclosure shall be constructed of 0.064 Carbon steel and aluminum. The enclosure shall be painted with powder coat paint with a minimum of 1.5 mil thickness.

Environmental.

The UPS shall meet or exceed NEMA temperature standards from –40c to + 74c. Communications, Control & Diagnostics LED indicators shall be provided for line monitoring, battery mode,

charging, low battery, fault / bypass load level, battery level and ground fault. Manual test functions shall be available for alarm function, low battery, battery fail, bypass and overload. An RS 232 port with communication software shall be provided for real time UPS operational status in place of a relay status card when required.

The relay status card shall have the following I/O via contact closure:

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REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

1. Bypass ON
2. AC fail or out of tolerance.
3. AC normal or in tolerance.
4. Inverter is operating (ON)
5. Battery low
6. Battery failed or bad
7. UPS general alarm
8. Ground (logic)
9. Apply 6 to +25VDC
10. B etween pin 9 and 10, will shut the UPS down

Options.

The UPS must be able to accept the following future options

- SNMP/WEB monitoring.
- 24/7 Adjustable perpetual timer.
- Generator input option for hot swap bypass switch.
- Rack mount hot swap bypass switch.

In place of the relay card, an SNMP card can be installed that shall support TCP/IP, UDP, SNMP, and HTTP protocols and shall provide the SNMP MIB for UPS monitoring and UPS status. Remote access to UPS real time information including unit identification, data logging and UPS status in real time shall also be provided on a by unit basis. It shall be possible to use Microsoft Internet Explorer for remote viewing of the following:

1. UPS load
2. Battery Charger status
3. UPS operation Normal/Alarm
4. Input Voltage
5. Output Voltage
6. Battery Voltage
7. UPS Temperature

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REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

8. UPS information logging

9. Remote UPS battery testing.

10. Send output email if UPS status has changed

11. Built in reset with panel mounted led indicators for SNMP status.

The SNMP card shall have the following status LEDs:

LED(1)	Green LED: Status receiving Yellow: Data Transmitting
LED(2)	Green: SNMP connecting Yellow: SNM P functioning

The optional 24/7 timer shall be integral to the UPS. It shall include a DB9 connector to provide the connection and programming to the timer. This timer shall be programmable for any number of flash delays related to the time of day. It allows the complete flexibility of flash delay or skipping the flash during that particular event related to traffic flow and even holidays. The time shall have the follow features:

1. 7 days, 24 hrs Flash delay timing.

2. Perpetual Clock.

3. Maximum of 31 setting per day.

4. Timing resolution to the minute.

5. 4 Possible commands per event.

6. Real-time operation, editing functions will not interrupt the unit's functions.

7. J-Tag port for instant preload of complete 7-day schedule file.

8. SPDT 10 amp 240VAC /24VDC ratings.

9. Input Voltage 110 to 240VAC or 24VDC unregulated supply.

10. Plus! Capable of scheduling for holidays or specific year/dates.

11. Capable of operating at 2400 baud micro-modem for direct phone connection

12. Capable of operating at 1200 to 230,000 baud rate on a serial port.

13. Capable of log retention

An optional generator input shall be available for the UPS.

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REVISION OF SECTION 614
CCD DOUBLE CONVERSION UNINTERRUPTED POWER SUPPLY SYSTEM

Reliability:

Calculated MTBF shall be 120,000 hours based on component ratings. When bypass switch is installed, system MTBF shall increase to 160,000 hours.

Hot Swap Bypass Switch:

A hot bypass switch shall be provided and wired to function within the UPS system. The bypass switch shall have the following characteristics:

Bypass Rating:	30 amps maximum
Bypass Transfer:	Automatically to line in 20ms, '0' crossing at full load
Control:	Rocker On/Off switch indicating 'Auto' and Bypass
Relays:	AC internal Load relay at 'Zero Crossing' with parallel function DC relay for interlocking and protection failsafe mode to N/C for AC power direct to load when failure occurs or in Bypass position.
Protection:	Internal Snubber circuit for spike attenuation during transfer at 'Zero' crossing. Internal fuse required.
Connections:	Flush mounted Anderson Power connector. With locked and keyed.
Indicators:	LED for Line Available, Bypass, Ups On Line, UPS Available.
Dimensions:	7.5 x 5 x 2.5
Weight:	1.4 lbs

Warranty:

A standard (2) two year manufacturer warranty shall be provided for all electronic components. All batteries shall carry a one year warranty.

Subsection 614.13 shall include the following:

Emergency Vehicle Traffic Signal Priority Control System units shall include a four-channel card and the number of detectors as shown on the plans. Emergency Vehicle Traffic Signal Priority Control System shall be measured and paid by the number of intersections at which the system is installed. The item shall include all labor, materials, and ancillary hardware required to provide a fully functioning system to the satisfaction of the Engineer.

Subsection 614.14 shall include the following:

Traffic signal double conversion uninterrupted power supply system and installation will not be measured and paid for separately, but shall be included in the cost of the Traffic Signal Controller and Cabinet.

12. COVER MEP SYSTEM

12.1 General

12.1.1 The Developer is responsible for the design, installation, testing and commissioning of the mechanical, electrical and plumbing systems for the Cover mechanical, electrical, and plumbing (MEP) System.

12.1.2 The Developer shall deliver the Cover MEP System to provide for the safe and efficient operation and maintenance of the I-70 Mainline so as to minimize risk to Users, both in terms of controlling the likelihood of serious incidents with adequate lighting, signing and traffic control systems, Intelligent Transportation System (ITS), and mitigating the severity of incident consequences through effective fire protection systems and procedures.

12.1.3 The Cover MEP System shall include:

a. The fire and life safety system, including:

i. Mechanical ventilation;

ii. A Fixed Firefighting System (FFFS) and associated water supply systems (required to limit the maximum reasonable design fire to that which is manageable by the longitudinal ventilation system);

iii. Fire detection systems;

iv. Emergency facilities including Emergency panels and fire hydrants;

v. Control systems required for system operation, monitoring, and control.

b. Cover lighting;

c. ITS;

d. Signage;

e. Cover specific drainage system; and

f. Water and power supplies to support the above.

12.1.4 The fire and life safety system shall be designed and installed to:

a. Provide early detection of vehicle fire events in the Cover;

b. Facilitate rapid and effective operator response;

c. Instigate and manage effective self-rescue; and

d. Facilitate effective Fire Department intervention.

12.1.5 Individual system specifications provide minimum extents of systems/assets and are not intended to present prescriptive limits. The Developer's design solution and implementation methods may require interventions that exceed the stated minimum design requirements in order to deliver the stated Performance Requirements for Cover MEP System as specified in Schedule 11 Operations and Maintenance Requirements.

12.1.6 The Developer is solely responsible for the analyses, reports, design, drawings, detailing, clearances, manufacture, supply, coordination, installation, integration, commissioning, testing and operation of the systems. The Developer shall design the Cover MEP system to ensure functional coordination and integration of all the individual systems. The Developer's Construction Work shall include all necessary incidental Activities, services and actions required to deliver a fully functional system that meets the requirements of the Project Agreement.

12.1.7 All equipment mounted in the Cover shall be mounted in such a way that it meets all design standards both in normal and Emergency use. This shall include measures such as mounting equipment outside of vertical clearance requirements on the Cover walls adjacent to I-70 Mainline or recessing all low-level equipment to not protrude into the horizontal clearance requirements.

12.2 Applicable Standards

12.2.1 The Cover MEP System shall be designed to comply with Schedule 10A Applicable Standards and Specifications. The requirements of the National Fire Protection Association (NFPA) standard 502 and associated standards and specifications generally apply. In accordance with NFPA 502, the Cover is classified as *Category C* for fire protection and fire life safety purposes.

12.2.2 The Developer shall design, install, test, commission and put into operation the Cover MEP System in accordance with standards listed herein, the Construction Standards specified in Schedule 10A Applicable Standards and Specifications and the requirements specified in this Section. The extent of the systems shall include the whole of the Cover (including I-70 Mainline, Portals etc.), immediate approaches, all associated plant/equipment rooms and spaces, yards, interconnecting spaces (including pipes, ducts, cabling etc), local and remote control centers etc., unless stated otherwise.

12.3 Durability

12.3.1 All equipment used in the Cover MEP System shall be protected against temperature range and atmospheric corrosion, including saline atmospheres. Materials used shall not be susceptible to mold growth, or attack by vermin or other life forms. All components shall have a minimum design life of 20 years.

12.3.2 All cable management systems (CMS) i.e. trunking, trays, conduit, brackets, enclosures etc. for equipment and ancillary items inside the bores of the Cover (including on the Portals and on the cross bore escape doors) shall be manufactured from grade 316L stainless steel.

12.3.3 Enclosures shall have minimum penetration protection rating to withstand sustained water jetting at a pressure of 1450 psi (10 MN/m2) for a period of 15 minutes without penetration of water or loss of surface finish, together with resistance to dust ingress.

12.3.4 Enclosures shall have a high impact resistance. Durable finishes shall be provided to all materials to resist mechanical stress due to moisture, traffic exhaust fumes, Cover washers brush, cleaning detergents, etc.

12.3.5 Enclosures shall be designed to be free draining so that water does not ‘pond’ on any surfaces.

12.4 Pipework

12.4.1 The Developer shall use pipe work with anchor joints avoiding the use of concrete anchor or thrust blocks. However, additional anchoring or restraint shall be provided to the pipe work where required. The Developer shall consider the effects of surge within the fire and water distribution systems and shall provide a surge suppression system or devices to counter the effects of surge.

12.4.2 The water and fire mains shall be adequately insulated and trace heated where subject to freezing. The mains passing through the Cover shall be insulated and trace heated. Trace heating shall be monitored on the Developer’s Command Control and Monitoring System (CCMS). Fire suppression distribution mains shall be insulated and trace heated up to the section control valve as directed by the system provider. Domestic water services within plant rooms shall be insulated and trace heated. Insulation shall be fire resistant and smoke retardant.

12.4.3 Pipework shall have electrical earth bonding.

12.4.4 Section isolation valves shall be provided at suitable locations and spacing along the Cover to facilitate inspection and maintenance Activities and automatic air release and drain valves shall be provided where necessary. These valves shall be monitored on the CCMS.

12.5 Fixtures

12.5.1 No fixture shall be made within two inches of the edge of a transverse movement joint in the Cover structure.

12.5.2 All fixings shall be Grade 316L stainless steel, with a grade appropriate to the environmental conditions in the Cover and the design life of a particular item of equipment to be supported.

12.5.3 All fixings shall be designed to withstand a temperature of 842ºF for a minimum period of one hour without loss of their design load carrying capacity. All fixings for equipment shall be designed so as to not overstress, damage or affect the performance or life of the structural fire protection system.

12.6 Electromagnetic Environment

The Developer shall ensure that any electrical and electronic equipment shall not be interfered with by, nor shall interfere with, any communications systems (including public radio and Emergency services radio).

12.7 Cables

All cables shall be low smoke and fume and shall be suitable for its CMS in a Cover environment. Any cables exposed to daylight shall be ultraviolet resistant.

12.8 Training

The Developer shall provide operator and maintenance personnel training for each system prior to being put into use. This training shall include all aspects of operation, maintenance, configuration and future modification of the installation. The Developer shall provide training to the Department's staff who will be required to operate the I-70 Mainline and Cover MEP System in the event of the Developer's control room being unusable. The Developer shall provide in a suitable electronic format all training material and notes suitable for Department to train staff in the future. The Developer shall also develop suitable operator and maintenance personnel testing regime to ensure that all staff are trained and understand the systems to a competent level.

12.9 Special Tools

The Developer shall provide any special tools required to maintain the equipment, including licenses for any software required to maintain the system.

12.10 Cover Reference System

The Developer shall agree with the Department and establish a common referencing system for the length of the Cover, for identifying position along the I-70 Mainline and for referencing within asset registers. This shall be coordinated with the rest of the I-70 Mainline. This referencing system shall be clearly and indelibly marked within the Cover I-70 Mainline, using a method Accepted by the Department. The referencing system shall be coordinated with the Emergency response systems to ensure efficient identification of zones within the Cover during an Emergency for the purposes of operator response, system activation and Fire Department information.

12.11 Cover Design Baseline Report

12.11.1 The Developer shall submit a Final Design Baseline Report (consistent with the Draft Cover Design Baseline Report submitted with the Proposal) to the Department for Acceptance in accordance with the Project Schedule. The Cover Design Baseline Report shall provide a system description that includes as a minimum the following Elements:

a. System block diagrams for the ventilation, FFFS, fire detection, power supply, fire alarm, water supply, and data communication systems;

b. Proposed ventilation system type and supplier;

c. Proposed FFFS type and supplier;

d. Fire detection system type, model and supplier;

e. CCTV camera system type, model and supplier;

f. Operator interface system;

g. Monitoring and control system;

h. Proposed system operation;

i. Hydraulic and pneumatic calculations;

j. Computational Fluid Dynamics (CFD) analysis process, model, cases and assumptions;

k. Proposed approach to demonstrating FFFS performance;

l. Analysis of the safety functions for all fire and life safety systems as prescribed in IEC61508-1

m. Lighting and signing;

n. ITS; and

o. Drainage.

12.12 Emergency Response Plan

12.12.1 The Developer shall prepare an Emergency Response Plan (ERP), as described in NFPA 502. The Developer shall conduct coordination meetings with the Department and stakeholders including City and County of Denver (CCD) Fire Department, to discuss the details of the Cover MEP System operation and Emergency procedures. The ERP shall be submitted by the Developer to the Department for Acceptance at the same time as the Final Cover Design Baseline Report.

12.12.2 The Developer shall update the ERP and submit no later than 60 Calendar Days prior to opening of the Cover, or any part thereof, for Acceptance by the Department.

12.13 Ventilation

12.13.1 Scope

A Cover MEP System shall include a Cover Ventilation System (CVS). The scope of the CVS specification is limited to the ventilation of the Cover over I-70 Mainline only and excludes any plant room or service building ventilation systems.

12.13.2 System Requirements

The CVS shall be of longitudinal concept comprising jet fans. The system shall be developed for the following two principal operating modes:

a. Normal and congested operations: in situations where the traffic induced airflow is insufficient to maintain vehicle emitted pollutants to within acceptable levels, additional airflow will be generated by the ventilation system; and

b. Emergency operations: in the event of an Emergency incident, the ventilation system shall be operated to control the smoke and hot gasses and shall discharge the smoke and gases via the exit Portal.

12.13.3 Design Objectives

a. The CVS shall be designed to meet the following objectives:

i. To provide sufficient capacity for adequate pollution control in the Cover over the I-70 Mainline during normal and congested traffic conditions;

ii. To provide sufficient ventilation to maintain tenable conditions in the Cover over the I-70 Mainline for the evacuation of Users during a fire;

iii. Maintain reasonable conditions for the intervention and rescue operations of the Fire Department.

12.13.4 Design Criteria

a. Normal and congested operations

i. The CVS shall provide air flow to induce sufficient outside air into the Cover to ensure acceptable levels of vehicle emission contaminants are maintained throughout.

ii. The permissible exposure limits for each bore shall be in accordance with Environmental Protection Agency and FHWA standards. Maximum limit levels for normal traffic operations are given in Table 12-1 below:

Table 12-1 Maximum Pollutant Levels

Pollutant	Maximum Limit
Carbon Monoxide, CO	120 ppm
Nitrogen Dioxide, NO_2	1 ppm
Nitric Oxide, NO	15 ppm
Particulate Matter, PM	0.007 m^{-1} extinction coefficient

b. Emergency Operations

i. The CVS shall be designed such that, in the event of fire during normal, free-flow unidirectional traffic conditions, the system shall induce airflow in the incident bore that moves smoke and hot gases towards the exit Portal, maintaining tenable conditions for self-rescue. Emergency service intervention will be via a route upstream of the fire event.

ii. The Cover and approach/exit highways sections shall be designed to facilitate the rapid clearance of traffic from the Cover downstream of any incident. In the case of a fire during congested unidirectional traffic (i.e. where traffic may be stationary both sides of a vehicle fire), the Developer shall develop operational procedures and a ventilation response to provide the best conditions for escape within the constraints of the CVS design for normal, free-flowing unidirectional traffic. The non-incident bore can be assumed to be operationally available for evacuation.

iii. The design fire size for the Cover MEP System shall be 30 MW convective peak heat release rate. The CVS is required to be capable of generating at least the critical velocity for smoke control for the design fire at the worst-case location in the Cover during an adverse Portal pressure condition.

iv. The CVS shall be designed to minimize recirculation of smoke from the incident bore to the non-incident bore during an Emergency.

v. The CVS shall be designed to meet the air flow requirements with the cross connecting doors between the bores open during evacuation.

12.13.5 Noise

Noise levels in the Cover, under full operation of the CVS, shall account for any specific requirements of the Fire Department and not be so high as to interfere with the use of Emergency communications systems. The maximum level as defined in NFPA 502 shall not be exceeded.

12.13.6 Ambient conditions

The Developer shall base the CVS design on the following ambient conditions:

a. Ambient temperature of 100°F;

b. Local elevation of 5250 foot; and

c. Adverse Cover Portal pressure condition representative of a credible worst case headwind defined as the headwind not exceeded 5% of the time.

12.13.7 Jet fans

a. The jet fans shall be of the horizontal shaft unidirectional type complete with silencers with bell mouth on both ends of the jet fan and shall fit outside of the headroom and width clearances. The mounting of jet fans parallel or inclined to the roadway surface shall be taken into account in their selection, design and manufacture. The jet fans may be inclined, fitted with adjustable air flow directors or fixed deflectors for setting the optimum jet effect.

b. Each jet fan unit shall be capable of producing a minimum design thrust to meet the specified design criteria under local worst case atmospheric conditions. The thrust developed per power of motor input power shall be taken as an assessment of the fan efficiency.

c. The complete jet fan assembly, including but not limited to the fan, fan motor and cables shall be capable of operating in the ambient temperature during normal operation.

d. Anti-vibration mountings shall be provided to reduce the transmission of vibrations, at frequencies associated with the fan running speeds and their first three multiples (harmonics), to levels that are acceptable for transmission of noise and vibration through the structure.

e. Jet fans shall be equipped with vibration monitors to enable the transmission of vibration levels to the CCMS. The CCMS shall be programmed to provide an alarm indication when the level of vibration exceeds that specified by the manufacturer. The design shall be such that under Emergency operations any vibration alarms shall be inhibited and shall not result in the switching off of a jet fan.

f. Jet fans shall be equipped with motor temperature monitors to enable the transmission of temperature levels to the CCMS. The CCMS shall be programmed to provide an alarm indication when the level of motor temperature exceeds that specified by the manufacturer. The design shall be such that under Emergency operations any motor temperature alarms shall be inhibited and shall not result in the switching off of a jet fan.

g. The complete fan assembly, including but not limited to the fan, fan motor and cables, shall be designed and installed such that it not suffer mechanical, electrical or structural failure when operating at full capacity in smoke laden air with an ambient temperature of 482°F for a minimum period of one hour. The Developer shall include a manufacturer's type test certificate showing that the design meets these requirements as part of its design submittal.

h. The whole fan assembly shall be waterproof and capable of withstanding water spray from maintenance washing vehicles and the FFFS. A drain fitting with cap shall be located in the lowest part of the fan housing, if not self-draining by manufacturers design.

12.13.8 Jet fan motors

The jet fan motors shall conform to the following requirements:

a. Suitable for use in the corrosive atmosphere;

b. Suitable for use with soft starters;

c. Be totally enclosed fan ventilated cage rotor type;

d. Protected motor enclosure;

e. Lifting lugs or eyes shall be provided; and

f. Capable of being run in an inclined position, not greater than 15° from the horizontal with no detrimental effects.

12.13.9 Ventilation Control System

A ventilation control system (VCS) for the CVS shall be integrated into the CCMS to:

a. Permit interface between the operator and CVS equipment components;

b. Provide automatic ventilation control in normal operations, ensuring the Cover is maintained within required environmental conditions that can be adjusted when required;

c. Operate in real time to provide live monitoring, control and fault reporting of the CVS equipment;

d. Provide real time indication of status and alarm conditions at various operator locations;

e. Interface with and provide data transfer between related systems;

f. Provide a secure interface between the CVS equipment and the automatic incident/fire detection systems in the event of fire in the Cover; and

g. Minimize effects and constraints on tunnel operations through automatic reconfiguration modes in the event of plant failure or routine maintenance Activities.

12.13.10 Monitoring Equipment and System

Monitoring equipment shall be provided for the continuous monitoring of Visibility, CO, NO_2, air speed, air flow direction and temperature in the Cover and:

a. For pollution monitoring, a logical method for control shall be developed for normal, maintenance and congested operations and safeguard the fans from frequent switching;

b. Pollutant and visibility monitors shall be located adjacent to the traffic lanes in the Cover, at locations where the worst level is anticipated;

c. All monitoring equipment shall be calibrated to represent the average air quality within the Cover;

d. Monitoring system shall be provided to facilitate operational data to be recorded and stored for analysis. Data to be recorded shall include pollution levels, Cover air speed, fan operations and alarm states;

e. For the measurement of pollutants, at least two sampling points shall be provided at each side of the each bore of the Cover (eight in total). The location of sampling points shall avoid dilution by air circulating from the Portals;

f. Monitoring stations shall be located and configured so as to provide data to drive the VCS for the management of pollutants in the Cover to acceptable limits;

g. Monitoring equipment shall not be installed near to jet fan inlets and outlets so as to affect the performance of the CVS; and

h. Six air speed and direction monitors shall be installed: two in each bore of the Cover to provide information to the operator on the flow speed and direction of air inside the Cover and two outside the Cover near to each Portal at a location suitable to provide information on external ambient wind conditions to the operator. Proposed locations shall be detailed in the Developer's Fire System Performance Report.

12.13.11 Interfaces to Other Systems

a. Command, Control and Monitoring System

The CCMS shall read and display the status and settings of all fans and control equipment. The operator shall be able to control the ventilation on a per bore basis using a series of pre-configured plans on the CCMS.

b. Fixed Fire Fighting System

The CVS shall work in tandem with FFFS. The CVS shall be designed to be operated in a way that minimizes the impact on the effectiveness of the FFFS.

c. Fire Detection and Alarm System

The CVS shall interface to the fire detection and alarm system to determine the location of any active fire detections.

d. Pollution Monitoring System

The VCS shall interface with the pollution monitoring system via the CCMS, so that ventilation rates in the Cover can be set automatically, according to dilution requirements.

12.13.12 Computational Fluid Dynamics Model

Effective performance in operation of the combined FFFS and the CVS shall be demonstrated through analysis with a CFD model and comparison to full scale fire test data relevant to the proposed design. The CFD model shall be validated for the proposed performance of the CVS and FFFS based on prior full scale tests of the proposed systems considering ambient conditions listed in this Section.

12.13.13 Information on ventilation system performance requirements, design criteria and the demonstration of how the design meets the requirements for Emergency operation shall be placed in the Fire System Performance Report.

12.14 Fixed Firefighting System

12.14.1 Scope

The Developer shall design and install the FFFS to serve the full length of both bores of the Cover. The FFFS shall be designed to achieve the following objectives in the event of a vehicle fire in the Cover:

a. To control the fire and limit peak heat release rate and smoke production;

b. To reduce temperatures in the vicinity of the fire to aid self-rescue operations;

c. To reduce temperatures in the vicinity of the fire to reduce likelihood of fire spread; and

d. To maintain conditions that are reasonable for Fire Department intervention.

12.14.2 Basis of Design

The Developer shall design, provide, install, test and commission the FFFS in accordance with the Applicable Standards and Specifications and the requirements of the Authority Having Jurisdiction (AHJ). The Developer shall allow for all performance testing and demonstrations to the Department. The Developer shall undertake all necessary surveys and investigations to validate its design including, but not limited to Utility surveys, investigations, inquiries with relevant Governmental Authorities and for obtaining all Governmental Approvals.

12.14.3 Design Criteria

a. A key design objective for the FFFS is to suppress a fire of potential to grow to 120 MW to an extent that provides conditions suitable for effective self-rescue and reasonable conditions for fire service intervention and for those Users unable/unwilling to self-rescue until assistance is provided.

b. Water storage tanks and booster pumps or other means shall be provided to supply the FFFS and shall be maintained at required flow and pressures.

c. The FFFS shall be designed so as to limit the maximum heat release rate to be handled by the CVS to 30 MW convective heat release rate. The design case to be considered shall be of a heavy goods truck with an ultrafast fire growth rate according to NFPA 92 up to a maximum of 120 MW.

d. The time period between a fire ignition to fire detection shall be based on the performance characteristics of the fire detection system. The performance of the fire detection system shall be validated through full scale testing.

e. The representative timeline of a design fire scenario, including characterization of the design fire, fire growth, fire detection, activation of Cover fire safety systems, self-rescue and Fire Department intervention shall be presented in the Fire System Performance Report.

12.14.4 FFFS Requirements

The entire Cover shall be protected by the FFFS, which shall be zoned and shall comprise:

a. Water storage tank, or suitable alternative water supply provision in accordance with NFPA and Fire Department requirements;

b. Pumps and controls;

c. Wet main distribution pipework from the tank, to pump room and routed into and along the walls in the Cover near the soffit level;

d. Section valves to create suppression zones of the minimum section length of 80 foot to 100 foot in length (three zones are activated during a fire equating to a protected area of 240 feet to 300 feet long);

e. Dry secondary distribution pipework at high (soffit) level of the structure to feed the suppression nozzles above the traffic lanes; and

f. Suppression nozzles connected to the secondary distribution network; the number of nozzles across the Cover width and nozzle banks shall be longitudinally spaced to provide sufficient and homogeneous flow pattern distribution in the area to be protected.

12.14.5 Water Supply

a. The Developer shall design, install and commission a water supply system to provide water supply for the FFFS. The water volume for the FFFS shall be sized based upon a minimum demand of one hour of simultaneous operation for three zones FFFS in the event of a fire, assuming no tank refill is occurring during the fire event.

b. The water supply shall be adequate to provide water at the minimum working pressure at three adjacent sections simultaneously. Under dynamic full fire flow conditions, all locations within the system shall be demonstrated to have adequate pressure for the FFFS. Operation of the FFFS shall not reduce the operating pressure or flow rate of the Cover standpipe system.

c. The Developer shall be responsible for arranging the source of the FFFS water supply, which may be:

   i. Direct mains supply from the local/municipal water company: capable of supplying the system minimum demand at the most disadvantageous location for the pipeline system for the required period; at a water quality that complies with the manufacture's requirements; or

   ii. In order to provide adequate resilience for the water supply, a dedicated enclosed water storage tank may be considered for the FFFS which shall be located in a new plant room - at a water quality that complies with the manufacture's requirements; or

   iii. Combination of i) and ii)

12.14.6 Storage Tank

a. For the tank option, if selected by the Developer as contemplated within Section, the quality of the incoming supply water that feeds the tank shall meet the performance requirements of the FFFS. Water treatment facilities shall be provided where required subject to water quality analysis and suitability for the system design.

b. Water storage room shall be provided with bunding and drainage flood protection.

c. Construction material of the tank shall be selected to avoid corrosion or water contamination.

d. The water storage tank shall have safe maintenance access.

e. In order to guarantee continuity of the system operation the water storage tank shall:

i. Have sufficient working capacity above the alarm levels to cope with the maximum fire suppression system demand for a continuous period of no less than 60 minutes; such capacity and contents shall be labeled outside the tank;

ii. Have a division plate to allow maintenance and cleaning of the tank while providing a reduced level of storage;

iii. Include an automatic mains water top-up facility;

iv. Be equipped with a quick fill connection linked to a breeching inlet within a clearly identifiable box remote from the Cover but be fully accessible for Fire Department or others' use;

v. Maintain the water temperature at a minimum of 39°F to prevent freezing. Antifreeze shall not be considered for freeze protection;

vi. Be provided with bunding and drainage arrangements.

f. The following conditions shall be monitored and alarmed:

i. High water level;

ii. Low water level;

iii. Water overflow in bunding area; and

iv. Water temperature levels.

g. The following fittings shall be provided as minimum:

i. Drain valves and overflow outlets (drain valves to be padlocked shut and monitored on the CCMS);

ii. A valve between the tank and the pumps for maintenance purposes;

iii. Venting to the atmosphere with appropriate screen/strainers to avoid ingress of debris and insects, etc. to the tank; and

iv. External visual tank contents gauges and temperature gauges.

12.14.7 Pumping System

a. If selected by the Developer as contemplated within this Section the FFFS shall be equipped with one pump station to be located in a designated pump room.

b. Pump units shall consist of one or more pumps and driven by electrical motors. The electrical power supply shall be dual redundant with automatic switch over. The electrical power supply shall comply with the Applicable Standards and Specifications.

c. Pump sets shall be arranged with at least one pump available as a standby in the event of a duty pump failing.

d. The pump station shall be capable of delivering 110% of the full design flow rate demanded by the FFFS at the required system pressure to supply the protected area - the three spray zones within the Cover - at the minimum pressure specific to the nozzle.

e. Hydraulic and pneumatic calculations submitted with the Cover Design Baseline Report shall:

i. Apply only appropriate and validated calculation procedures for pressure loss calculations (i.e. the formulae of Darcy-Weisbach for liquid flow systems);

ii. Include provision for the elimination of the effects of surge and water hammer effects in section valves and the pipework system as a whole;

iii. Provide assurance that the pumped flows are acceptable in terms of flow rate and pressure at each nozzle location with full system deployment; and

iv. Provide pump and system characteristics curves. In addition performance curves shall be provided indicating the efficiency and power requirements including the operating range.

f. The following equipment/fittings shall be provided as minimum within the pump station:

i. Isolating valves;

ii. Safety valves for each pump set at 115% of the operating pump pressure;

iii. Diverter valves;

iv. Manifolds;

v. Filters between the tanks and pump sets to be 100% redundant or self-cleaning and provide a by-pass for blockages;

vi. Flow meters;

vii. Pressure gauges;

viii. Controls; and

ix. Surge prevention devices.

g. Water treatment shall be provided where required subject to water quality analysis and suitability for the Developer's system.

h. Pump rooms shall be kept at a temperature above 39°F at all times in order to prevent freezing. Rooms shall be equipped with a suitable drainage and ventilation system.

i. A jockey pump or an equivalent of such pump shall be used to pressurize the main pipe to a suitable stand-by pressure up to the section valves (wet pipes). Provision of non-return valve between the pump and the pipes as well as test valve at the pump outlet shall be also provided.

j. A booster pump or an equivalent of such pump shall be provided between the tank and the pump after the main filter to ensure the required pressure from the water tank should the Developer deem necessary. Redundancy of 100% for this pump (if used) shall be provided.

12.14.8 Pipeline System

a. The pipework shall be dimensioned to ensure that the minimum pressure tested is achieved at all nozzles of the activated sections. The maximum allowable pressure loss shall be within the limits given by the maximum and minimum tested pressure.

b. A Hardy-Cross or similar pipe network analysis shall be performed for a variety of flow scenarios to identify the maximum and minimum dynamic pressures in the system when operated in various hydraulically remote states. This analysis shall identify the maximum flow velocities expected within the pipe, to ensure that the pipe hanging system is adequate to resist the bend forces expected in the pipe network. Pressure surge mitigation shall be sized to safely handle water hammers expected during the transient operation of the system when various remotely located valves are closed. Where necessary, the Developer shall incorporate into the structural design, any strengthening necessary to eliminate any overstress. Sleeves shall be cast in the hole and the annulus between pipe and the sleeve shall be suitably fire stopped.

c. The Cover shall be equipped with a main pressure line feeding through section valves into individual zones and associated nozzle arrays.

d. Pipe material shall be tolerant against corrosion. Adequate support shall be provided for all exposed pipework, nozzles and valves to:

   i. Prevent undue stresses being imposed on them during operation and while joints are uncoupled for maintenance purposes;

   ii. Comply with expected levels of load, vibration, water hammer, air velocities and heat resistance; and

   iii. Minimize the effect of high vehicle impact against nozzles and pipework.

e. The wet sections of the pipework shall be maintained at a minimum temperature of 39°F at all times, so the design shall include provisions to guarantee this minimum temperature requirement (e.g. insulation and trace heating).

f. Filters and strainers shall be provided to pipelines that lead water from the tank to the pump station to avoid any particles entering the pumps, hence blocking the distribution system.

12.14.9 Valves

a. All valves constituting the FFFS shall be provided with means of monitoring status which shall be reported to the CCMS. Section valves shall be robust, remotely controlled and fully leakage free.

b. Valve enclosure boxes shall be fire resistant and provide sufficient resistance to permit continuous and full functioning of valves for a minimum period of two hours with the fire suppression system operating, taking into consideration the anticipated air temperature immediately outside the enclosure during the design fire of 30 MW.

c. Fire resistant valve enclosure dimensions shall be minimized to reduce any risk of traffic collision.

d. Adequate support shall be provided to the section valves to withstand the expected air velocities in the Cover.

12.14.10 Nozzles

a. Nozzle installation shall be at high level (soffit) in the Cover.

b. The nozzle design shall allow for the expected ventilation velocities of the longitudinal ventilation system and shall be designed to deliver water droplets appropriate to meet the fire performance acceptance for the design fire.

c. All nozzle openings shall be designed for protection against contamination and clogging.

d. All nozzles shall be installed in full accordance with the manufacturer's design and installation manual taking into account: positioning, distance from walls and other obstructions, orientation and Site hazards.

12.14.11 Local Control Facilities

a. The Developer shall provide the following facilities in a protected room near the entry Portal to each bore for Fire Department use:

   i. Fire main manual wheel valve to allow the dry standpipe hydrant main to be filled from the water supply (automated control to be provided as a backup);

   ii. Control panel with override facilities and status indicators for the FFFS;

   iii. Control panel with direct override facilities and status indicators for the ventilation system;

   iv. Fire alarm control panel;

v. Fire Department hose connections to connect sufficient hoses to supplement FFFS should supply fail;

vi. Radio coverage repeater; and

vii. Sufficient heating and ventilation to avoid condensation or corrosion as well as lighting.

b. All equipment shall be housed within sealed IP66 enclosures.

c. The protected rooms shall be provided in accordance with local codes and standards.

12.14.12 Electrical Equipment

a. Electricity supply for the pumps shall be provided from low voltage distribution boards. Control panels shall be provided at the pump locations. Local controls shall be provided to operate pumps individually from the pump locations.

b. All power and control cabling shall be sized correctly taking into account the full load current of the plant, characteristics of the protection devices and voltage drop.

c. Pumping equipment and section valves shall be instrumented to enable remote monitoring of mode and condition to the CCMS.

12.14.13 Control System

The control system shall:

a. Secure interface between the operators and the fire suppression plant;

b. Provide real time indication of status and alarm conditions at various operator locations;

c. Interface with and data transfer between related systems;

d. The FFFS control system shall be integrated with the CVS;

e. Be scalable and have flexibility for future changes in operational modes;

f. Operate in real time to provide live monitoring, control and fault reporting of the plant services;

g. Faults and alarms shall be reported to the CCMS;

h. Provide operator access without the need for computer programming skills to carry out the day to day functions;

i. Provide the option of manual override if the Cover MEP System operator deems necessary;

j. Provide a manual back-up at the pump station for independent control of the pumping plant.

12.14.14 Interfaces

a. Ventilation System

Effective performance in operation of the combined FFFS and the CVS shall be demonstrated through analysis with a CFD model as described in this Section. The results shall be included in the Fire System Performance Report.

b. Command, Control and Monitoring System

The design shall facilitate the FFS status, settings and faults to be reported to the CCMS including: Tank levels and temperatures, pump and valve system status.

c. Fire Detection and Alarm System

The CCMS shall provide a secure interface between the FFFS and automatic incident detection (AID) system in the event of fire in the Cover to determine the location of any active fire zone.

12.15 Cover ITS and Communications System

12.15.1 This subsection describes all Cover ITS requirements. The Developer shall incorporate these requirements into its design for a fully integrated ITS for the Project.

12.15.2 The Developer shall provide and operate a Control Center for the Cover. It shall be equipped with all the necessary facilities to safely operate the Cover CCMS. All the systems shall be designed to an appropriate level of resilience and redundancy in accordance with IEC61508.

12.15.3 The Developer shall provide communications links to the Fire Department for fire alarms and the CTMC as a fall back center.

12.15.4 Communication System

a. The Developer shall provide a communication system for the Cover to inform the Users, members of the public, the Emergency services and the Department. The communication system shall comprise the following four sub-systems:

   i. Emergency roadside telephones;

   ii. Radio Rebroadcast;

   iii. Voice Alarm (VA)/Public Address (PA); and

   iv. Emergency way-finding signage.

b. The four subsystems will provide the following facilities:

   i. Emergency Roadside Telephones

   Emergency roadside telephones shall be provided in the Cover and on its immediate approaches in both directions. The telephones shall be connected directly to a telephone on the Cover Control Center operator's desk. An additional telephone shall be provided at the CTMC and it shall be possible for the CTMC operator to pick up incoming telephone calls from the Cover in the event that the Developer's Control Centre operator is unable to answer the call. The system shall be designed such that in the event that an Emergency call is not answered within 10 seconds, all control room telephones shall ring and the first operator to pick up the call will be connected to the Cover Emergency telephone. This time period shall be adjustable by a suitably accredited system operator.

   ii. Radio Rebroadcast

      A. The radio rebroadcast shall be in accordance with NFPA 72 and:

         (I) Allow the Emergency Services personnel to communicate by radio with their commanders and one another whilst inside the Cover;

         (II) Allow operations and maintenance staff to communicate by radio with their operations center and with one another while in the Cover;

         (III) Allow Users to receive domestic radio broadcasts using their in-car radios. These radio broadcasts shall be processed within the Cover roadway management system to allow the broadcast program to be interrupted and replaced with an appropriate Emergency public safety message; and

         (IV) Allow all Users in the Cover to make and receive cellular telephone calls.

      B. The radio rebroadcast systems shall meet all local, state and federal laws and standards relating to the transmission of radio services and the Developer shall negotiate and obtain all necessary licenses. Any apparatus emitting radio energy shall be specified and supplied to ensure that there is no interference to any radio or other electronic services outside the Cover.

iii. Voice Alarm/Public Address

A. The voice alarm and public address VA/PA system shall be designed and installed in accordance with NFPA 72 and shall allow Cover operations staff to make Emergency public safety announcements in the Cover and on its immediate approaches. The VA/PA system shall reproduce sound such that clear and intelligible speech can be heard by members of the public at all points in the Cover and within twenty-five feet of the Portal under all conditions of background noise likely to be experienced (e.g. with or without the CVS running and with or without traffic flowing).

B. The functionality and priority of the system shall be determined during detailed design. It shall be possible for the list of available messages and the priority level of that message when selected by the operator to be changed by any suitably accredited system operator.

iv. Emergency Way-Finding Signing

In order to aid the evacuation of Users in the event of an incident in the Cover, internally illuminated Emergency way-finding signs will be provided. Each of the signs shall have two faces with the sign on one face pointing to the entrance Portal and the sign on the second face pointing to the exit Portal. The internal illumination of these signs shall be controlled from the Cover Control Center such that in the event of an incident only the signs that show a safe route shall be illuminated at any time. The Emergency way-finding signs shall otherwise always be illuminated.

12.15.5 Data Communication System

The Developer shall design and install a data communication system to provide and facilitate a reliable, high bandwidth fault tolerant communications to all equipment throughout the Cover and its immediate approaches. It shall be integrated with the Project's ITS infrastructure to provide reliable communications to the Control Centers. It is anticipated that this will be provided by means of a single high reliability fiber-optic based Ethernet network. Fault tolerance shall be provided by means such as a 'self-healing' ring network topology. Critical equipment shall be provided with IP connections to two different Ethernet switches and all Ethernet switches shall be resistant to the effects of MAC address 'flapping' and broadcast storms. The Developer shall ensure security of his systems and those connected to it (including but not limited to the Department's ITS system) in accordance with ISO 27001.

12.15.6 Lane-Use Signals

a. The Cover ITS shall include lane-use signals (LUS) mounted on gantries at the entry Portal of each bore. The operation of these Portal LUS shall be controlled by the Project ITS in such a way that if any Closure (or a total directional Closure) is set on either the Portal signals or the LUS on the next gantry downstream of the Cover, then these settings will be copied to the LUS in the Cover and on the gantry immediately upstream of the Cover. The Project ITS system shall interface with the CCMS such that if CCMS detects a condition likely to be a danger to Users, then the Cover can be closed using the Portal signals controlled by the Project ITS.

b. LUS mounted within the Cover shall have enclosures fabricated from 316L grade stainless steel and shall be mounted in such a way that galvanic corrosion is minimized.

12.15.7 Variable Message Signs

a. Variable Message Signs (VMS) controlled directly by the Cover ITS and CCMS shall be provided at both entry Portals of the Cover and on its immediate approaches. The CMS shall be capable of displaying messages with wording pre-agreed with the Department at the design stage. The CMS shall be used to inform drivers of full or partial Closure of the I-70 Mainline in the Cover or more generally of conditions ahead.

b. The system design shall include a facility whereby the Department will have the capability to change the message set for the CMS from the CTMC.

12.15.8 Closed Circuit Television

a. The Developer shall provide pan, tilt and zoom Closed Circuit Television (CCTV) cameras with wash/wipe facilities and associated transmission equipment in the Cover and on its immediate approaches. The CCTV pictures shall be transmitted to the Cover Control Center and linked to the CCMS for operational monitoring, where they shall have recording capability. Recordings from all CCTV cameras shall be made and retained for a minimum duration of 30 Calendar Days to allow for the analysis of any incidents that might have taken place before being overwritten (unless specifically marked for retention by an operator).

b. The Developer shall provide a sufficient number of cameras to ensure that 100% coverage within the Cover and its immediate approaches is achieved with all cameras in their 'home' position with no blind spots. Cameras shall be mounted over the running lanes in groups of three, the middle camera of each group shall be a thermal camera. One shall be over the ramp lane, one over the center of general purpose lanes and one over the Tolled Express Lane.

c. The CCTV camera images shall be transmitted to both the Cover Control Center and the CTMC.

12.15.9 Ramp Meter System interface

The CCMS shall interface to the ramp metering systems on the junctions either side of the Cover. This interface shall permit the CCMS to close the approaches to the Cover and to expedite the flow of traffic downstream of the Cover in the event of an incident.

12.15.10 Vehicle Detection System

The Developer shall provide a vehicle detection system within the Cover and its immediate approaches. The vehicle detection system shall provide the following facilities:

a. Traffic speed and flow data;

b. Detection and alarm for a single stationary vehicle in the Cover;

c. Detection and alarm for congested traffic flow in the Cover;

d. Detection and alarm for congested traffic flow downstream of the Cover; and

e. Detection and alarm for a vehicle travelling in the wrong direction within or approaching the Cover.

12.15.11 Fire Detection and Alarm System

The Developer shall install an automatic Fire Detection and Alarm System (FDAS) in accordance with the provisions in NFPA 72, including fire alarm control panels. The fire detection system shall be capable of locating a vehicle fire to within a longitudinal distance of 25% of the length of a single FFFS zone. The fire detection system shall be integrated with the FFFS and the CVS to ensure effective and timely response to fire to meet the performance requirements for the FFFS and other safety systems.

12.15.12 Information on how the Cover ITS and communications systems are to be operated in an Emergency with demonstration of how the design facilitates effective self-rescue and Fire Department intervention shall be placed in the Fire System Performance Report.

12.16 Command Control and Monitoring System

12.16.1 Scope

a. The Developer shall design and install a CCMS to provide a comprehensive fault monitoring and management facility for all electrical and mechanical systems installed in the Cover as well as to facilitate the operation and management of the roadway in the Cover and its approaches. The CCMS design shall include provisions to integrate the Project ITS and the Cover ITS described in this Section as necessary to support the CCMS and to enable the CCMS to interface with the operation and management for the I-70 Mainline as a whole as well as either side of the Cover and the associated ramp management systems.

b. The CCMS shall include the ability to monitor the status of the Cover MEP System and provide facilities to:

   i. Over-ride the automatic operation of the CVS;

   ii. Over-ride the automatic operation of the drainage system;

   iii. Over-ride the automatic operation of the electricity distribution system;

   iv. Over-ride the automatic operation of the lighting system;

   v. Over-ride the automatic operation of the Emergency way finding signs;

   vi. Over-ride the automatic operation of the FFFS;

   vii. Control the operation of the radio rebroadcast systems;

   viii. Control the operation of the voice alarm and public address system;

   ix. Monitor the status of the fire main system;

   x. Monitor the status and manage alarms from the AID system;

   xi. Monitor the status and manage alarms from the Fire Detection system;

   xii. Monitor Plant Room systems including heating, ventilation, and air conditioning (HVAC), lighting, intruder alarm, fire alarm, FFFS etc;

   xiii. Monitor the status and manage alarms from all environmental and other sensors;

   xiv. Monitor the status of the power distribution system; and

   xv. Request, via an appropriate interface, specific actions from the traffic management systems (including automatic responses to state changes and alarms from the systems being monitored).

c. The CCMS shall be integrated with the Project ITS to allow the operators to manage and co-ordinate the operation of the I-70 Mainline in the Cover and along both approaches. These include:

   i. LUS;

   ii. VMS;

   iii. Communications Systems;

   iv. CCTV;

   v. Ramp metering systems; and

   vi. Vehicle detection systems.

d. The CCMS shall be based upon a programmable logic controller (PLC) based Supervisory Control and Data Acquisition (SCADA) system. Interfaces to systems both in the Cover and on the surface streets may be required.

12.16.2 Basis of Design

The Cover and its approaches shall be controlled and managed from a staffed Cover Control Center where the operators will be able to interact with the CCMS to ensure the safety of all Users within the Cover.

12.16.3 Design Criteria

The Cover has been assessed as Category C under NFPA 502. As such the requirements of NFPA 502 section 4.5/7.5 (Emergency Communications), 7.4 (Fire Detection/CCTV), 7.6 (Traffic Control) and 7.16.1 (Emergency egress and signage) shall apply as mandatory requirements.

12.16.4 CCMS Control and Monitoring Facilities

The CCMS shall provide the Cover operations staff the ability to monitor the operation of the Cover and the immediate approaches.

a. Ventilation

i. The CCMS shall allow the Cover operations staff the ability to monitor the operation of the CVS. It shall be possible to monitor the current status of all ventilation fans on a single screen using a pictorial representation. From this screen it shall be possible to interrogate the detailed status of individual fans and fan controllers.

ii. The CCMS shall have the facility for the operator to over-ride the normal automatic operation of the CVS, either as whole or just specific fans. In an Emergency, automatic and manual settings on the CVS shall be over-ridden by a predefined Emergency ventilation plan.

iii. The CCMS shall have the ability to raise an alarm to the operator if any Element of the CVS becomes faulty. It shall raise a second alarm if the fault will cause the Cover to operate below the agreed minimum operational threshold.

b. Drainage

i. The CCMS shall provide Cover operations staff the ability to monitor the operation of the drainage system. It shall be possible to monitor the current status of all drainage system components on a single screen using a pictorial representation. From this screen it shall be possible to interrogate the detailed status of the drainage system components such as level sensors, pumps and valves.

ii. The CCMS shall provide the facility for the Cover operator to over-ride the normal automatic operation of the drainage system (e.g. inhibit or turn on pumps or close/open valves). In an Emergency, manual settings on the drainage system shall be over-ridden by a predefined Emergency drainage plan.

iii. The CCMS shall raise an alarm to the operator if any Element of the drainage system becomes faulty. The CCMS shall raise a second alarm if there is an imminent risk of flooding within the Cover.

c. Lighting

i. The CCMS shall provide the Cover operations staff the ability to monitor the operation of the lighting system in the Cover. It shall be possible to monitor the current status of the entire lighting system on a single screen using a pictorial representation. From this screen it shall be possible to interrogate the detailed status of individual lighting system Elements.

ii. The CCMS shall provide the facility for the Cover operator to over-ride the normal automatic operation of the lighting control system. In an Emergency, manual settings on the lighting control system shall be over-ridden by a predefined Emergency lighting plan.

iii. The CCMS shall raise an alarm to the operator if any Element of the lighting system becomes faulty. It shall raise a second alarm if the fault will cause the Cover to operate below the agreed minimum operational threshold.

d. Fire Main

The CCMS shall monitor the current status of the fire main system including pumps, pump controllers, trace heating, level sensors and input pressures. The CCMS shall monitor the pressure on the fire main within the Cover. The CCMS shall raise an alarm to the operators if the pressure is outside predefined limits.

e. Fixed Firefighting System

i. The CCMS shall monitor the current status of the FFFS. It shall present the current status of the FFFS to the Cover operators on a graphical user interface (GUI).

ii. The CCMS shall raise an alarm if any Element of the FFFS becomes faulty. It shall raise a second alarm if the fault will cause the Cover to operate below the agreed minimum operational threshold

iii. The CCMS shall allow the Cover operator to selectively operate the FFFS based upon the fire location reported by the fire detection system.

f. Emergency Way-Finding System

i. The CCMS shall monitor the status of all Emergency way-finding signs and present this to the Cover operators via a GUI. In the event that an Emergency is detected, the appropriate Emergency plan shall be set automatically.

ii. The CCMS shall raise an alarm to the Cover operator if any Element of the Emergency way-finding system becomes faulty. It shall raise a second alarm if the fault will cause the Cover to operate below the agreed minimum operational threshold.

g. Radio Rebroadcast Systems

i. The CCMS shall monitor the status of all radio rebroadcast systems and present this to the Cover operators via a GUI. The CCMS shall raise an alarm to the operator if any Element of the radio rebroadcast system becomes faulty. It shall raise a second alarm if the fault will cause the Cover to operate below the agreed minimum operational threshold.

ii. The CCMS shall allow the Cover operator to broadcast speech messages selected from a list of predefined Emergency safety announcements into the Cover and its immediate approaches through a voice break-in facility in the domestic radio rebroadcast system. The CCMS shall recommend the message to be broadcast based upon the information available within the CCMS.

h. Voice Alarm/Public Address System

i. The CCMS shall monitor the status of the voice alarm public address system and present this to the Cover operators via a GUI. The CCMS shall raise an alarm to the operator if any Element of the voice alarm and public address system becomes faulty. It shall raise a second alarm if the fault will cause the Cover to operate below the agreed minimum operational threshold.

ii. The CCMS shall allow the Cover operations staff to broadcast speech messages selected from a list of predefined Emergency safety announcements into the Cover and its immediate approaches through a system of public address loudspeakers. The CCMS shall recommend the message to be broadcast based upon the information available within the CCMS.

i. Vehicle Detection System

i. The CCMS shall monitor the status of the vehicle detection system and present this to the operators via a GUI. The CCMS shall raise an alarm to the operator if any Element of the vehicle detection system becomes faulty. It shall raise a second alarm if the fault will cause the Cover to operate below the agreed minimum operational threshold.

ii. The CCMS will monitor the vehicle detection system for incidents. If an incident is detected, the CCMS shall alert the operator and recommend the actions to be taken.

j. Fire Detection System

i. The CCMS shall monitor the status of the fire detection system and present this to the Cover operators via a GUI. The CCMS shall raise an alarm to the operator if any Element of the fire detection system becomes faulty. It shall raise a second alarm if the fault will cause the Cover to operate below the agreed minimum operational threshold.

ii. The CCMS shall monitor the fire detection system for indications that fire may be present and if a fire is detected, the CCMS shall alert the operator and recommend the actions to be taken. If no response is received from the operator within a predetermined time limit, the recommended action shall be automatically applied.

iii. The automated fire detection system shall be supplemented with manual fire alarm call points situated at every Portal, every cross bore door and at all Emergency panels. The operation of the manual call points and the automated fire detection systems shall be coordinated by a fire alarm control panel and monitored by the CCMS. The fire alarm control panel shall permit the fully automated control of the fire and life safety systems by the CCMS but shall allow local manual override facilities.

iv. The fire detection systems shall have a direct connection to the Fire Department station/control room as well as the Cover Control Center.

k. Plant Room Systems

The CCMS shall monitor the status of all plant room equipment such as the HVAC, lighting, intruder alarm or building fire alarm and present this to the Cover operators via a GUI. The CCMS shall raise an alarm to the operator if any Element of the plant room equipment becomes faulty.

l. Power Distribution System

The CCMS shall monitor the status of the power distribution system and raise alarms to the operators in the event of any faults in the power distribution system. The CCMS shall also monitor the status of the Uninterruptible Power Supply (UPS) systems and raise alarms if the Cover systems are being powered solely from the UPS. The CCMS shall raise an alarm if either of the incoming mains supplies have failed. It shall raise a second alarm if both incoming supplies have failed and will recommend the closure of the Cover.

m. Power Supply to CCMS and ITS Equipment

All CCMS and ITS equipment shall be supplied by an Uninterruptible Power Supply (UPS) in accordance NFPA 70. This UPS shall be sized to sustain the operation of all critical systems for a minimum of two hours.

n. Ramp Meter System Interface

The CCMS shall interface to the ramp metering systems on the interchanges either side of the Cover. This interface shall permit the CCMS for the Cover to close the approaches to the Cover and to expedite the flow of traffic downstream of the Cover in the event of an incident.

12.16.5 Interfaces

The CCMS shall provide interfaces to the operations, maintenance and management system and the Project ITS . These interfaces shall permit:

a. The CCMS to report and manage faults to the Maintenance Management Information System;

b. The CCMS to demand control actions from the Project. ITS. These actions shall include:

i. Request the complete closure of either bore;

ii. Request the complete closure of both bores;

iii. Request entrance ramp closure upstream of Cover entry Portal; and

iv. Request Emergency traffic clearance signal plan on traffic signaled junctions downstream of the Cover exit Portal.

12.16.6 Location and Protection of ITS Elements

Wherever possible, ITS equipment will be mounted in the plant rooms of the services buildings. Wherever this is not possible, the equipment will be installed in high corrosion resistance stainless steel enclosure mounted outside of the vehicle gauge. These enclosures will be sealed to prevent the ingress of high pressure water jets (such as those used for wall cleaning and from the FFFS) and dust including that arising from the burning of diesel fuels by road vehicles.

12.16.7 Non Functional Requirements

a. Emergency Points

At each of the locations of the Emergency telephones, hydrants and fire alarm call points, the Developer shall provide an Emergency point. Emergency points shall be clearly labeled as such, fabricated of stainless steel and, as a minimum contain portable fire extinguishers, the Emergency telephone and required firefighting equipment.

b. Cable Management System

A full cable management system will be provided in the cornice on each side of the roadway and on the soffit on the centerline of the roadway. The cable management system will be provided using open high corrosion resistance stainless steel cable tray, trunking or conduit.

c. Cabling Requirements

Cables installed in the Cover shall be constructed using low smoke and fume insulation. Cables containing halogens will not be permitted in the Cover. Cabling for essential and life-safety systems shall be constructed from fire survivable materials.

12.17 Electrical Systems

12.17.1 Basis of design

The Developer shall design, provide, install, test and commission all electrical power systems in accordance with the appropriate NFPA standards or other such Applicable Standards and Specifications or local AHJ. The Developer shall allow attendance at all performance testing and demonstrations by the Department and relevant Local Agencies or appointed representatives. The Developer shall undertake all necessary surveys and investigations to validate its design including, but not limited to utility surveys, investigations, enquiries with relevant Governmental Authorities and for obtaining all necessary Governmental Authorities.

12.17.2 Design Criteria – Electrical Power

a. The Developer shall verify with the AHJ whether the requirements of NFPA 502 – Chapter 12 Electrical Systems (clause 12.1.5) are to be incorporated into the design.

b. The electrical systems shall be designed to support life safety operations, fire Emergency operations, and normal operations. The electrical systems shall be designed to allow for routine maintenance without disruption of traffic operation.

c. The main electrical distribution shall be configured, interconnected and controlled to allow all services to the Cover to remain operational in the event of a single power supply transformer failure in the substation at either end of the Cover.

d. Main low voltage switchboards shall be configured with interlocking switchgear to allow for Emergency standby generator installation to be connected to serve all essential services supplies to the Cover.

e. Diesel generators shall be provided for backup purposes in order to run the Cover in the event of a failure of both electrical supplies.

12.17.3 Design Criteria – Emergency Power

a. Emergency Standby Generator

Emergency Power shall be provided by an Emergency standby generator in accordance with Article 700 of NFPA 70. (For Emergency and standby power systems as NFPA 110).

b. The following systems shall be connected to the Emergency power system:

i. Emergency lighting;

ii. CCMS and ITS;

iii. Exit signs;

iv. Emergency communications;

v. Cover drainage monitoring;

vi. Emergency ventilation;

vii. Fire alarm and detection;

viii. Closed-circuit television or video; and

ix. FFFS.

c. Emergency Power Circuits

Emergency circuits installed in the Cover and ancillary areas shall remain functional for a period of not less than one hour, for the anticipated fire condition.

d. Emergency circuits shall comprise one of the following:

i. Fire-resistive cables;

ii. Circuits embedded in concrete that are protected by a two-hour fire barrier system; and

iii. By the routing of the cable system external to the roadway using diversity in system routing as approved, such as separate redundant or multiple circuits separated by a one hour fire barrier, so that a single fire or Emergency event will not lead to a failure of the system.

e. Emergency Power UPS System

i. Two separate UPS systems shall be provided within each of the services buildings located near each end of the Cover. One of these will feed the lighting system whilst the other will feed the remaining safety critical plant.

ii. The UPS specification shall be developed based on the following;

A. Three-phase, on-line, double-conversion, static-type, UPS units with 120 minute battery Autonomy;

B. 20% Spare capacity;

C. N+1 parallel redundant configuration; and

D. External wraparound bypass unit

12.17.4 Design Criteria – Containment

Containment shall be provided throughout the Cover for all cabling services. Separate containment systems shall be provided for power and control/communications cabling, segregated in line with Good Industry Practice. Armored cables shall be run on cable trays with non-armored cables run in trunking or conduit to suit the required routing. Control and communications cables shall be run in conduit.

12.17.5 Design Criteria – Cabling

All cables and associated materials shall be insulated or clad using low smoke, zero halogen (LSOH) materials and where required, certain cables will be fire survivable cables.

12.18 Lighting

12.18.1 Scope

a. The Developer shall design and install lighting systems in accordance with the Illuminating Engineering Society RP-22-11 to provide coverage for the full length of the Cover to achieve the following objectives:

i. To provide safe illumination for the passage of vehicular traffic at the posted speeds through the Cover;

ii. To reduce any visual adaptation problems caused by the external luminance of the external scene when approaching the Cover by the uses of increased threshold illumination ensuring that stationary traffic or other obstructions are visible to the approaching traffic;

iii. To provide exit lighting if necessary to cope with visual adaptation problems for drivers leaving the Cover;

iv. To provide Emergency lighting to cover the safe egress of drivers in an Emergency either by the means of dedicated means of egress or via cross passage doors;

v. To reduce maintenance costs and associated health and safety risks by mitigating/controlling maintenance procedures and their frequency;

vi. To reduce energy costs associated with the lighting systems; and

vii. To allow full control of the lighting systems to allow stepless dimming control between the lighting zones.

12.18.2 Site specific conditions

The Developer shall take into consideration in its design the east - west orientation of the Cover, which creates specific lighting demands in terms of Threshold Luminance levels, the external view of the Cover has been assessed as being scene 4 from figure 3 in RP-22-11. This means that the threshold level has been initially assessed to be 26 cd/ft^2 due to the posted speed of 60 mph.

12.18.3 The Developer's General Obligations:

The Developer shall be responsible for providing the following services:

a. Design and development of the Cover general and Emergency lighting;

b. Develop, design, install and put into operation an integrated lighting control system that complies with the applicable standards and interfaces with the CCMS to facilitate a coordinated operation and management of the Cover;

c. Develop a system that facilitates monitoring by the CCMS of all faults and alarms generated by the lighting system including individual lighting fixture and control gear feedback; and

d. To provide operational and maintenance manuals and as built drawings in sufficient detail and depth that the day to day operation of the Cover can be carried out in an efficient manner by the maintenance operatives.

12.18.4 Choice of Light Source

The lighting system shall be light emitting diode (LED) based.

12.18.5 Basis of design

a. Base the design upon a high wall reflectance of >30% to increase the inter-reflected component and help reduce the need for more lighting fixtures in the Threshold Zone in particular.

b. This section of the document relates to the systems located within the Cover only.

12.18.6 Design Criteria

a. The lighting systems shall be designed and constructed to meet with the standards identified within IESNA RP22-11.

b. Table 12-2 shall be used as criteria for the Cover design.

Table 12-2 Lighting Criteria for Cover

Criteria	Value
Posted Speed	60 mph
AADT	>15000
Cyclists	No
Wall reflectance	70/5020
Cladding height	9.8ft
Maximum threshold luminance (taken table 2 RP-22-11)	26cd/ft^2
Transition Zone 1	26-10.6 cd/ft^2 average
Transition Zone 2	10.6-4.6 cd/ft^2 average
Exit zone	To be agreed
Daytime Interior zone	0.9 cd/ft^2 average
Night Time Luminance	Min 0.3 cd/ft^2
Uniformity ratio ave/min	2.0/1
Uniformity ratio max/min	3.5/1
Veiling illuminance ratio	0.3

c. The lighting system within the Cover shall be designed as the philosophy for a full tunnel with variable lighting systems in the Threshold Zones, Transition Zones, Exit Zones and constant light within the Interior Zone. The Cover lighting shall to be reduced to a lower night-time level 0.9cd/ft^2.

d. The lighting system shall aid visibility of the Cover and any stationary traffic within the Cover. The lighting system shall be able to adapt to the external luminance of the external scenes when approaching the Portals or exiting the Cover. The lighting at the Portals shall increase and reduce accordingly either by switching or dimming. Solar shades may be considered as an alternative to excessively high levels of luminance within the threshold and high concentrations of fixtures. The lighting system shall be chosen to minimize maintenance requirements and be suitable for the aggressive environment within the Cover.

e. The lighting systems shall be provided with the ability to dim in the range of 1-100%. The lighting system shall be controlled by a system of luminance photometers located within the first 65 foot of the Cover at both Portals. The luminance photometers will measure the external scene luminance. Threshold lighting shall be provided as necessary based on orientation of the Cover. Initial brightness of the external Portal scene has been taken to be scene 4 (RP-22-11 figure 1).

f. The lighting fixtures will have symmetrical optics and be fixed to the structural soffit of the underside of the Cover. The fixtures shall be in rows or multiple rows aligned with the center line of the lanes. The spacing between the fixtures will be chosen to avoid flicker, noting that continuous line is preferable. The fixtures shall consist only of the LEDs and their optical lens housed within a sealed IP66 enclosure capable of being pressure hosed. The fixtures are to be connected to the electrical distribution panels (EDP)s via specially constructed cables that have IP66 connectors. The EDPs are to house the LED drivers in fire rated enclosures. The fixtures are to be supplied by two separated electrical supplies providing interleaved circuits so that alternate fixtures are fed from the same supply.

12.18.7 Emergency Lighting

The Emergency lighting within the Cover traffic zone shall be provided by a subset of the general lighting. The Emergency lighting shall be fed by a segregated fire survival cable network capable of running the Emergency lighting for the statutory minimum duration of two hours. The Emergency lighting level shall be a minimum 1 ft cd (10.8 lux) for a minimum duration of two hours. The Cover Emergency lighting will enable way finding to the dedicated means of egress. The escape exits shall be illuminated to 10 ft cd (108 lux). The sources of power for the Emergency lighting and standby lighting will be the UPS systems.

12.18.8 Lighting Control Systems

a. The Developer shall design, supply, install, commission and set into operation a complete lighting control system. The Cover lighting will be controlled by an automatic lighting control system. The lighting control system will utilize an open lighting control protocol to control, vary, scene-set and fault monitor all the fixtures within the traffic zone of the Cover.

b. The lighting control system shall be interfaced with the CCMS system and provide information in coordinated manner on the status of the lighting system. The lighting controls system shall also include luminance sensors monitoring the actual luminance provided by the lighting system on the pavement in each of the lighting zones. Alarms shall be generated when designed maintained illuminance levels are not met.

c. The lighting control system shall use industry recognized protocols such as DALI or 1-10V to control the lighting a then to be integrated on to the communications backbone and then to the CCMS. Information from the Cover Portal photometers shall be communicated to the lighting control system with appropriate output from the CCMS to the lighting control system. The Developer shall provide appropriate graphics pages for indicating real time status, faults and alarms on the lighting systems on the GUI. Individual fixtures/drivers will have a unique address and report status. Light output and any faults including run hours to the central lighting monitoring software located on the ITS server/head-end.

12.18.9 Portal Photometer System

The Developer shall design, supply and install an automatic Portal dimming system to balance threshold luminance in line with the real time external luminance. The photometers shall use the CIE 88 L_{20} philosophy for sampling angle of 20 degrees of the external scene. The photometers shall be duplicated for each Cover bore and be operated in a run and standby mode with automatic switch over on failure. The run time of each photometer shall be balanced over the period of four week period. The photometer system shall be interfaced with the CCMS.

12.18.10 Requirements

a. System Description

The Cover shall be illuminated for both day time and night time scenarios to provide a safe lit environment for vehicular traffic and routine maintenance works:

i. The lighting shall be designed for vehicular traffic in a uni-directional situation in each bore for a posted speed of 60 mph;

ii. The lighting shall include threshold transition and Exit Zones;

iii. The lighting shall include both standby and Emergency lighting provisions in line with Applicable Standards and Specifications and Project specific Site generated requirements;

iv. The lighting shall be automatically controlled to various design parameters to satisfy environmental conditions standard lighting functional requirements and non-standard incident requirements through dimming and scene setting regimes; and

v. The light fixtures and support installation shall be designed in such a manner to reduce consumed energy and minimize maintenance Activities.

b. Light fixtures

The fixtures shall be designed to a minimum of IP66 and shall have a designed service life of a minimum fifteen years. The luminaires shall be tested to IESNA LM79 for LED fixtures.

c. Light source

The Developer shall provide fixtures with LED light sources with a color rendering factor of $>60Ra_{14}$. The LEDs shall be arranged in such a manner as they all contribute to the whole of light distribution. The LEDs shall an L80 lumen depreciation factor at a minimum of 80,000 hours and shall a have a mortality of B10 at 80,000 hours. The Lumen depreciation factor shall be calculated according to IESNA LM80 for 6,000 hours at an ambient temperature of 95ºF.

12.18.11 Control Gear/Drivers

The Developer shall supply fully electronic control gear matched to the lamp source which shall function fully to either the 0-10v protocol or the DALI protocol.

12.18.12 Emergency and Standby Lighting

The Developer shall develop the Emergency lighting and standby lighting provisions in accordance with the Applicable Standards and Specifications. The Emergency lighting shall include all internal spaces including Emergency escape routes.

12.18.13 Lighting Control System

The Developer shall design a step less dimming lighting control system capable of minimizing energy usage and extending lamp life. The control system shall be fully integrated with the CCMS system and the Portal illuminance system. The system shall report full diagnostic information on each fixture, monitor faults, be capable of setting individual fixture outputs, cumulative scene setting and time scheduling and generate both common and specific alarms.

12.18.14 Electrical Equipment

The Developer shall provide an electrical system suitable for an IP 66 environment including cables, plug and socket arrangements cable support structure and fixings.

12.18.15 Interfaces

The interfaces as shown in Table 12-3 between the lighting and lighting control systems are identified as initial requirements and shall be finalized through the submittal review / acceptance and approval process.

Table 12-3 Lighting Control System Interfacing

System	Interface	Managing system
Ventilation	None	
Drainage	None	
Lighting	N/A	N/A
Fire main	None	
Fixed firefighting system	None	
Portal Photometer system	Dimming input via analogue system to CCMS and then digital signals to the lighting control system	CCMS linking photometers to Lighting control system
Emergency way-finding system	Testing and monitoring of system status	Lighting control system with status to CCMS
Radio rebroadcast systems	None	
Voice alarm public address system	None	
Vehicle detection system	Go to incident lighting scene	Signal via CCMS
Fire detection system	Go to incident lighting scene	Signal via CCMS
Plant Room systems	None	
Power distribution system	None	

12.19 Standpipes, Hydrants and Portable Fire Extinguishers

12.19.1 Scope

The Developer shall design and install standpipes, hydrants and portable fire extinguishers to provide coverage the full length of the Cover, which shall be available in the event of a fire in the Cover to be used to extinguish or suppress the fire.

12.19.2 Basis of design

The Developer shall design, provide, install, test and commission the FFFS and all fire suppression systems in accordance with the Applicable Standards and Specifications and the requirements of the AHJ. The Developer shall allow for all performance testing and demonstrations to the Department and relevant authorities or appointed representatives. The Developer shall undertake all necessary surveys and investigations to validate the design including, but not limited to Utility surveys, investigations, enquiries with relevant bodies and for obtaining all necessary Permits, approvals and consents.

12.19.3 Design Criteria – Standpipes

a. The Developer shall design, provide and install all valves, connections, hangers, inserts, piping, sleeves, fittings, and other appurtenances necessary to provide a fully functional and compliant standpipe system.

b. Standpipes shall be provided in both the eastbound and westbound bores and located in similar locations in each bore at each cross bore door and on the opposite wall. The piping

shall be embedded in the pavement and shall be cross connected at cross bore door locations such that either bore can be supplied by either main. Isolation valves shall be provided to enable sections of the system to be shut down for maintenance without shutting the entire system down. A hose connection shall be provided at each cross bore door, in each bore, located adjacent to the door.

c. The standpipe system shall be a dry pipe system supplied from the municipal water company mains supply. The Developer shall conduct testing in accordance with NFPA 14 to determine that the supply is capable of supplying the system demand for a minimum period of one hour and of delivering water to all hose connections on the system within 10 minutes or less. In the event that tests indicate that the supply is not capable of meeting the system demands, the Developer shall provide suitable water storage tanks and pumping equipment complete with jockey pump to maintain system pressures.

d. The required flow rate shall be 750 gpm at the hydraulically most demanding outlet. Allowance shall be made for two hydrants operating simultaneously. The calculation procedure shall be in accordance with section 7.10.1.2.2 of NFPA 14 or in accordance with the requirements of the AHJ. The minimum residual pressure at the hydraulically most remote 2.5 inch outlet shall be 100 psi. Pressure restricting valves shall be provided where the hydraulic head exceeds 100 psi.

e. Standpipes shall be Class 1 dry type system as defined by NFPA 14 subject to the agreement of the AJH. A temporary or permanent standpipe system shall be installed and tested during the construction phase in accordance with NFPA 14, NFPA 25, NFPA 502 and NFPA 241 and to the requirements of the AHJ.

f. Hose connection spacing shall be such that that no location within the protected area is more than 150 feet from the hose connection. Hose connection spacing shall not exceed 275 feet.

g. The entire standpipe system including valves shall be protected against freezing and shall be complete with all necessary status monitoring and alarms linked to the CCMS system.

h. The standpipe system shall be suitably protected from mechanical damage and vandalism.

i. Suitable back flow prevention devices shall be installed to prevent contamination of the Water Company supply and distribution system.

j. The standpipe system shall be provided with drain points to enable the entire system to be drained down.

k. The pipework system shall be protected from unequal settlement or structural movement by the use of appropriate flexible jointing couplings.

l. Suitable fire collars shall be provided where piping passes through fire rated structure.

m. A two way Siamese coupling shall be provided at both ends of each bore to allow the Fire Department to provide back-up water supplies, the location of these connections shall be agreed with the Fire Department. The Developer shall provide all fire hydrants and associated piping.

n. Standpipe fire hoses shall be housed in a “Hose Connection Station” which shall consist of a protective enclosure that also houses portable fire extinguishers. Each hose connection station shall have two, 2.5 inch, hose connections with an external thread in accordance with NFPA 1963 or as otherwise required by the Fire Department. The hose connection station cabinets shall be located in recesses in the side walls of the Cover to finish flush with the wall surface.

o. The Developer shall provide an appropriate signage system in accordance with NFPA 14 and to the approval of the Fire Department.

12.19.4 Design Criteria - Portable fire extinguishers

a. Portable fire extinguishers shall be provided in accordance with NFPA 502 with a rating of 2-A: 20-B: C and shall be located along the Cover of both the Eastbound and Westbound bores. They shall be co-located in approved hose connection stations and at intervals of not more than 300 feet. The maximum weight of the extinguishers shall be 20 pounds. The installation shall be in accordance with NFPA 10 and its associated reference documents.

b. The removal of an extinguisher shall be capable of being detected by the use of a pressure pad or similar device with an alarm raised via the CCMS system.

12.19.5 Design Criteria - Hose connection stations

The Developer shall design and construct hose connection stations with protective enclosures constructed of grade 316 stainless steel. The enclosure shall be provided with suitable alarms to indicate when a door has been opened and also where an extinguisher has been removed. The alarm shall be raised via the CCMS system. The hose connection station cabinets shall be located in recesses in the side walls of the Cover to finish flush with the wall surface.

12.19.6 Cover – Washing

In case the Developer chooses to perform Cover washing operations with a road tanker with suitable pressure washing equipment or other Accepted method, the Developer is not required to provide a piped water supply system within the Cover, for washing operations.

12.19.7 Information on how the Cover Standpipes, Hydrants and Portable Fire Extinguishers are to be operated in an Emergency with demonstration of how the design facilitates effective self-rescue and Fire Department intervention shall be placed in the Fire System Performance Report.

12.20 Drainage Systems

12.20.1 Scope

a. The Developer shall design and install a drainage system, in accordance with this Section and Schedule 10, Section 8 Drainage, for the full length of the Cover to collect and discharge water inflow to the Cover that results from the discharge of FFFS and standpipe fire suppression systems, seepage water penetrating through the structure, water washing operations, snow and ice melt and any surplus surface water overspill from the cut-off drainage system located at the Portals. The drainage system shall also cater for spillages of hazardous substances such as may occur following a fuel tanker accident. The drainage system shall be of sufficient capacity so as not to cause flooding to the roadway and associated areas.

b. The Developer shall, prior to undertaking any design works, consult with the appropriate Local Agency to agree the required method of collecting and managing the proposed drainage effluent. The Developer shall prepare and submit a Spill Prevention Control and Countermeasures Plan (SPCC) in accordance with the Colorado Discharge Permit System – Stormwater Construction Permit (CDPS-SCP). The Developer shall prevent the discharge of any sediment or pollutants into any storm drains or receiving waters.

12.20.2 Basis of design

a. The Developer shall design, provide, install, test and commission a drainage system in accordance with the requirements of NFPA 502, the Department's requirements and the FHWA or other such applicable standards or to the requirements of the local AHJ. The systems shall be complete and fully functional. The Developer shall allow attendance at all performance testing and demonstrations by the Department and relevant Local Agencies or their appointed representatives. The Developer shall undertake all necessary surveys and investigations to validate his design including, but not limited to, Utility surveys, investigations, testing, and inquiries with relevant Governmental Authorities and for obtaining all necessary Governmental Approvals.

b. This subsection relates to the drainage systems located within the Cover.

12.20.3 Design Criteria

a. The drainage system shall be of sufficient capacity so as not to cause flooding to the roadway and associated areas.

b. The drainage system shall be capable of preventing spillages of Hazardous Substances and inflammable liquids from propagating along the roadways and shall be constructed entirely of incombustible materials.

c. The drainage system shall consist of curb drains or inlet grates and gullies fitted with grit chambers and water seals, connected to a system of gravity collection drains located under the carriageway structure. The collection drains shall have manholes with grit chambers at intervals to enable maintenance and inspection of the drainage system. All gratings and manhole covers shall be lockable and of a duty to resist heavy truck loadings.

d. To prevent contamination of the storm-water drainage system, the drainage effluent shall be monitored for levels of contamination. The Developer shall either demonstrate the feasibility of an on-Site treatment and construction of such on-Site treatment facilities or construct facilities that contain the effluent for haulage and treatment off-Site. Where unacceptable levels of contamination are detected, the effluent shall be automatically diverted to a holding tank, a manual means of diverting contaminated effluent shall also be provided. The holding tank shall be complete with fire suppression systems, hydrocarbon sensors, effluent quality monitoring equipment, water level monitoring, and alarms and the like. All sensors and alarms shall be raised via the CCMS system. An alarm shall also be provided local to the plant.

e. Where drainage gullies are provided, the distance between gullies should be such that the catchment area for each gully will not exceed 2,700 ft^2 and so that the longitudinal distance between gullies shall not exceed 65 feet.

f. The Developer shall consult with the municipal drainage authority to confirm that their infrastructure drainage system is capable of receiving the design discharge without storage or attenuation.

g. Where a gravity connection to the municipal drainage authority drainage cannot be achieved, the Developer shall provide suitable pumping equipment to raise the effluent to a level that will enable connection. The pumping chamber, wet well and service chambers shall be classified for hazardous locations in accordance with NFPA 70 and 820. The installation shall be fitted with pollution and hydrocarbon sensors with alarms raised via the CCMS system. An alarm shall also be provided local to the plant.

h. All software utilized for the design shall be referenced in all calculations and reports produced by the Developer.

12.21 Plant Rooms

The Developer shall provide suitable plant rooms to house switchgear, control equipment and associated equipment in accordance with local codes and standards.

12.22 Requirements Management

12.22.1 The Developer shall develop and implement a comprehensive Requirements Management (RM) process for the Cover MEP System, defining how the technical requirements are parsed, captured, documented, derived, apportioned, traced, managed, verified, and validated.

12.22.2 The Developer shall develop and manage a requirements database for the management and reporting of the RM process. The requirements database shall include all requirements in these specifications and the requirements that may be added or modified during contract scope modifications.

12.22.3 The Developer shall furnish a conventional, off-the-shelf (COTS) product for a requirements management tool, which makes use of a spreadsheet or relational database for the management

of Cover MEP requirements. The Developer shall submit the Preliminary Requirements Traceability Matrix (RTM) to the Department for Information with the Final Cover Design Baseline Report.

12.22.4 The Developer shall provide updates to the RTM throughout the Project, as necessary.

12.22.5 The Developer shall keep the Department's version of the RTM synchronized with the Developer's requirements database by performing a monthly synchronization. Each requirement within the requirements database shall have a unique identifier, be unambiguous, and non-repetitive. Each requirement within the RTM shall be assigned a functional allocation, which allocates the requirements into the functional areas including the FFSS, fire detection system, CCTV, CCMS, power supply system, water supply system, and the ERP. Each requirement within the RTM shall be mapped to the associated deliverable where the requirement is addressed and to the specifications.

12.22.6 The Developer shall produce RTM reports. The RTM reports shall list each Project requirement from the Project specifications and provide traceability to each test procedure in which this requirement will be tested.

12.22.7 The Developer shall submit an RTM Report, with each RTM Submittal, that lists only those requirements addressed within the deliverable and the associated mapping of each requirement to where the requirement is addressed.

12.22.8 The Developer shall be responsible for testing every requirement listed in the RTM against pass/fail criteria stated in the Commissioning Test Plan.

12.23 Testing and Commissioning

12.23.1 Testing

a. The Developer shall perform testing on all equipment, systems, sub-systems and software to demonstrate compliance prior to delivery to Site. The test facility shall perform full functional testing of all parts of the overall system to be tested in the Developer’s testing facility. The test facility shall include interface testing and the simulation of all aspects of the Cover systems. The Developer shall note that testing shall include the testing of the integration with external equipment which shall be simulated by the Developer.

b. Particular testing requirements are detailed in the various standards for each system.

12.23.2 Commissioning

a. All mechanical, electrical, and software systems shall be tested as part of a complete commissioning program. The Developer shall arrange for commissioning testing to be performed in accordance with NFPA 13 and NFPA 502.

b. Commissioning tests shall include at a minimum the following Elements:

i. Component and equipment;

ii. Communication links;

iii. Status, control, alerts, and alarms;

iv. Interfaces between systems;

v. Integration among new and existing systems;

vi. Failover on faults and

vii. Functioning of redundant components.

c. The Developer shall arrange for commissioning to be carried out by a commissioning agent/engineer with demonstrated experience in commissioning tunnel systems within the past five years. The Developer shall complete commissioning of all systems for the

Department's Acceptance prior to opening any section on the I-70 Mainline for public use whether as a temporary detour measure or permanently after Substantial Completion.

d. The Developer shall prepare and submit a Commissioning Test Plan, for Acceptance, detailing how all the tests will be carried out prior to the start of any testing. The test plan shall be based on the technical specifications and performance characteristics of all devices, equipment, parts, assemblies, systems, subsystems, software and devices for the Cover.

e. A Full Scale System Test Program shall be prepared and submitted for Acceptance. The full-scale system test shall involve non-destructive testing of the all systems supplied and installed to demonstrate compliance with the functional performance requirements of the overall integrated system. The full-scale test shall also involve nominated representatives of the Department,

f. The scope, methods, and timing of the full-scale test shall be submitted in the Full Scale System Test Program prior to the proposed test date. A Full Scale System Test Report shall be prepared and submitted to the Department for Acceptance 14 Calendar Days after testing.

12.24 Manuals and Documentation

12.24.1 The Developer shall produce and submit to the Department, for Acceptance, a Functional Design Specification (FDS) supported by drawings for every system. Each submitted FDS shall contain a description of the detailed design relevant to the Cover MEP System operations.

12.24.2 The Developer shall submit all design calculations to the Department with each design submittal.

12.24.3 The Developer shall prepare a comprehensive Operations and Maintenance Manual in relation to the Cover MEP System. The documentation shall include documented software codes, fault finding flow charts and all necessary guides to allow the maintainer to make future changes and configuration. The Developer shall provide As-Built drawings and operation and maintenance documentation for every item of equipment. All final documents shall be issued in MS Word format and all final drawings in AutoCAD format. All interim documents may be issued in Adobe Acrobat format.

12.24.4 The Operations and Maintenance Manual shall include a complete parts list. The parts list shall include a list of all parts supplied, down to the lowest level part or assembly that is user-replaceable. Commodity supplies such as conduits, conductors, and pipes do not need to be included. The parts list shall include part numbers, description, system application or use, manufacturer, and supplier. The parts list shall identify sole-source and propriety parts. For all sole-source and proprietary parts, compatible or alternative parts shall be identified. The estimated Residual Life of parts that have a service life less than 30 years shall be identified.

12.24.5 The Operations and Maintenance Manual shall also include a complete consumable supplies list. The supplies list shall include a list of all materials required for routine maintenance of the equipment supplied under the Project Agreement. The supplies list shall include material name, description, function, application rate and frequency, manufacturer, and supplier.

12.25 Spare Parts

The Developer shall provide the manufacture's recommended spares. The spares shall comprise 10% of operational equipment rounded up to the nearest whole unit.

12.26 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the specified timeframes:

Table 12-4 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Final Cover Design Baseline Report	Acceptance	Prior to RFC Documents
Fire System Performance Report	Acceptance	Prior to RFC Documents
Emergency Response Plan	Acceptance	Submitted with the Final Cover Design Baseline Report
Requirements Traceability Matrix	Information	Submitted with the Final Cover Design Baseline Report
Functional Design Specification (FDS)	Acceptance	Prior to RFC Documents
Commissioning Test Plan	Acceptance	Prior to undertaking the testing
Commissioning of all system	Acceptance	Prior to opening
Full Scale System Test Program	Acceptance	Prior to undertaking the testing
Full Scale System Test Report	Acceptance	14 Calendar Days after testing
Operations and Maintenance Manual	Acceptance	Prior to Substantial Completion

13. STRUCTURES

13.1 General

13.1.1 The Developer shall design and construct all structures required to meet the Project requirements and make the Project fully functional in accordance with the requirements of the Project Agreement and this Section.

13.1.2 To advance longer-lasting highways, the Department encourages using innovative technologies and practices to accomplish the fast construction of efficient and safe highways and bridges. Consideration by the Developer of state-of-the-art technologies and elevated performance standards that result in improved safety, faster construction, reduced congestion from construction, improved quality, and user satisfaction are encouraged.

13.1.3 All construction, reconstruction and rehabilitation of structures shall be designed and constructed to the Ultimate configuration geometric requirements.

13.2 Applicable Standards and Software

13.2.1 All Construction Work required to be performed by the Developer pursuant to this Section shall comply with Schedule 10A Applicable Standards and Specifications, the relevant requirements listed in this Section, and Good Industry Practice.

13.2.2 Railroad Grade Separations

a. The Developer shall coordinate with the Railroads in accordance with Schedule 10, Section 10 Railroads for any structures Construction Work within Railroad right-of-way or affecting Railroad operations.

b. All Railroad grade separation structures shall be designed and constructed in accordance with the BNSF Railway-Union Pacific Railroad *Guidelines for Railroad Grade Separation Projects* and the American Railway Engineering and Maintenance-of-Way Association (AREMA) *Manual for Railway Engineering*. Structures, including permanent and temporary structures, shall be coordinated with the respective Railroads and are required to meet all applicable requirements.

13.2.3 Structure Aesthetics

The Developer shall comply with Schedule 10, Section 14 Landscaping and Aesthetics in its design and shall comply with the specified materials and finishes treatments, concepts and details for all components of all structures (bridges, retaining walls, noise walls, sign structures, etc.).

13.2.4 Load Rating

a. Load rating methodology shall be consistent with the design methodology, load factor rating (LFR) or load and resistance factor rating (LRFR).

b. The Developer shall review the latest inspection reports, As-Built plans and carry out visual inspections to load rate the existing bridges.

c. Thrust shall not be used in the design or rating of buried culverts.

d. Bridges and major culverts under railway tracks shall be rated in accordance with AREMA. For all other structures, the following rating software shall be used for the Project:

i. AASHTOWare BrR, Bridge Load Rating; and

ii. AASHTOWare BrR, Culvert Load Rating.

13.3 Design Requirements

13.3.1 All highway bridge structures shall be designed for 36 pounds per square foot (psf) dead load to account for overlays, as specified in this Section.

13.3.2 Bridge spans shall be proportioned to avoid uplift at supports due to non-seismic loads.

13.3.3 Design structures for thermal forces for cold climate temperature ranges.

13.3.4 Geotechnical Data

a. Preliminary subsurface investigations have been conducted for the Project and are provided in the Reference Documents. The Developer shall be responsible for any additional subsurface investigations that it considers necessary to complete the Construction Work.

b. The soil and rock samples collected as part of the geotechnical investigation are stored by and available from the Department. The Developer may submit a request to the Department to obtain these geotechnical samples (for inspection and testing as it may consider necessary to supplement its design) no later than 90 Calendar Days after Notice to Proceed (NTP) 1. At the end of 90 Calendar Days, if the Developer has not submitted such request, the Department will dispose of the samples. If the Developer does submit a request and takes possession of these samples, then the Developer shall be responsible for their storage and disposal.

c. Existing groundwater observation wells are present within the Site. The Developer shall be responsible for their abandonment or renewal of the Permits for these wells in accordance with Colorado Division of Water Resources requirements. The Developer shall be responsible for installing any additional groundwater observation wells it considers necessary to monitor water level or water quality, including applying for and obtaining the necessary Permits.

13.3.5 Materials

a. Concrete

i. Type II or Type I cement may be used for cast-in-place concrete. Type III cement may be used for precast concrete. High sulfate content soils shall require Type V cement. Class B concrete may be used for panel noise barriers. Class BZ concrete shall be used for drilled caissons. Class B concrete shall be used for filling post holes and slope paving. Class D or H concrete shall be used for all conventionally reinforced bridge decks. Class D concrete shall be used for bridge rails, abutments, piers, and walls. Class D, PS, or S40 concrete shall be used for all pretensioned or post-tensioned concrete. The concrete used for cast-in-place bridge decks shall be dense, with low permeability, highly resistant to abrasion, and it shall resist cracking due to creep and shrinkage. The bridge deck concrete shall have a maximum water/cement ratio (w/c) of 0.45, chloride permeability of 2000 coulombs or less in 56 Calendar Days as tested in accordance with American Association of State Highway and Transportation Officials (AASHTO) T 277, and shrinkage of 500 microstrain or less as tested per ASTM C157. If Class D concrete is used, the Developer shall use a standard Class D mix. The proposed mix design and procedures shall meet the above requirements and shall be submitted for Acceptance by the Department. The use of lightweight concrete will not be allowed.

ii. Minimum design concrete strengths shall meet the requirements of Section 601 of the CDOT *Standard Specifications*.

iii. Maximum design concrete strengths used for design shall be:

A. Cast-in-place: f'c = 6.0 ksi; and

B. Precast: f'c = 10.0 ksi.

b. Pre-Tensioning Steel

The maximum diameter for prestressing strands shall be 0.6 inch for a two inch minimum spacing and 0.5 inch for a 1.75 inch minimum spacing.

c. Post-Tensioning Steel Systems

The Developer shall provide corrosion protection for the strands consisting of grout-filled galvanized or non-metallic ducts. Grout shall meet the requirements of Section 618 of the CDOT *Standard Specifications*. Prestressing system plants shall be certified by the Post-Tensioning Institute (PTI). The diameter for strands shall be 0.6 inch or 0.5 inch.

d. Reinforcing Steel

The use of epoxy coated reinforcing steel for all bridges, walls, box culverts, and barriers shall adhere to the requirements of Table 1, Subsection 8.1 of the CDOT *Bridge Design Manual*. The design category for the anticipated level of de-icing salt application shall be "High". Abutments, pier columns, barriers, retaining walls, and any other reinforced concrete structures exposed to splash from adjacent roadway shall use epoxy-coated reinforcing steel. All reinforcing shall consist only of deformed bars per American Society for Testing and Materials (ASTM) A 615.

e. Structural Steel

i. Structural steel shall conform to AASHTO M 270, Grades 36, 50, 50S, 50W, HPS 50W, or HPS 70W.

ii. Additional structural steel grades to be used for any pedestrian structures and architectural structures shall include ASTM A106 or A53 for pipe shapes or ASTM A500 (Grade B) for steel structural tubing shapes.

13.4 Existing Structures

13.4.1 Removal

a. The Developer shall remove existing structures as shown in Table 13-2.

b. The removal of Railroad structures shall meet the requirements of the respective Railroad.

c. Bridge removal shall consist of the complete removal of all superstructure and substructure elements for the reconstruction of new structures at these locations.

d. Removal of the substructure shall be taken down to at least one foot below the future ground surface or subgrade at the lowest point of interface. Holes resulting from substructure removal shall be backfilled with structure backfill (Class 2) to the adjacent existing grades.

e. The Developer shall submit a Bridge Removal Plan, for each structure that is to be removed, to the Department no less than 14 Calendar Days prior to start of demolition. The Bridge Removal Plan shall detail procedures, sequences, and all features required to perform the removal in a safe and controlled manner. The Bridge Removal Plan shall provide complete details of the bridge removal process and meet the requirements as specified in Revision of 107 Performance of Safety Critical Work, located in the Project Special Provisions set out in Appendix A.

13.4.2 Load Rating Additional Existing Bridges

a. The Developer shall load rate the existing structures as shown in Table 13-1 and submit to the Department for Acceptance.

Table 13-1 Existing Structures to be Load Rated

Structure Description	Structure No.
I-70 Over Sand Creek	E-17-AER
I-70 Over Havana Street	E-17-VD
I-70 over UPRR spur track (near Havana Street)	E-17-VE

13.5 Bridges

13.5.1 Bridge superstructure types that would require falsework or shoring are permitted. All falsework shall be designed in accordance to the AASHTO *Guide Design Specifications for Bridge Temporary Works*.

13.5.2 The bridge structures and actions identified for the Project are listed in Table 13-2.

Table 13-2 Actions for bridge structures

Existing Structure No.	New Structure No.	Structure Location and Description	Action
E-17-UY E-17-US	E-17-AEU E-17-AEV	I-70 westbound over Brighton Boulevard I-70 eastbound over Brighton Boulevard	Removal and reconstruction Removal and reconstruction
E-17-FX	N/A	I-70 Viaduct (Brighton to Colorado)	Removal
N/A	N/A	UPRR Bridge over 46th Avenue	Removal
N/A	E-17-AEW E-17-AEX	UPRR over I-70 UPRR Service Road over I-70	New construction New construction
N/A	MISC-E-17-IT	Sanitary Sewer Bridge over I-70 (at York Street)	New construction
N/A	E-17-AEY	York Street over I-70	New construction
N/A	MISC-E-17-IU	Storm Sewer Bridge over I-70 (at York Street)	New construction
N/A	E-17-AEZ	Josephine Street over I-70	New construction
N/A	E-17-AEL	Cover (Columbine to Clayton)	New construction
N/A	E-17-AEN	Fillmore Street over I-70	New construction
N/A	E-17-AEO	Steele Street over I-70	New construction
N/A	E-17-AEP	Cook Street over I-70	New construction
N/A	E-17-AFA	BNSF Market Lead over I-70	New construction
N/A	E-17-AFC	Monroe Street over I-70	New construction
E-17-HU E-17-HT	E-17-AFD	Colorado Boulevard over I-70	Removal and reconstruction
E-17-HY E-17-HZ	E-17-AFF E-17-AFG	I-70 westbound over Dahlia Street I-70 eastbound over Dahlia Street	Removal and reconstruction Removal and reconstruction
E-17-HW E-17-HX	E-17-AFH E-17-AFI	I-70 westbound over Holly Street I-70 eastbound over Holly Street	Removal and reconstruction Removal and reconstruction
E-17-GC E-17-GD	E-17-AFJ E-17-AFK	I-70 westbound over Monaco Street I-70 eastbound over Monaco Street	Removal and reconstruction Removal and reconstruction
N/A		N Stapleton Drive over Denver Rock Island Railroad	Removal
E-17-EW E-17-DF	E-17-AFN E-17-AFO	I-70 westbound over Rock Island Railroad I-70 eastbound over Denver Rock Island Railroad	Removal Removal
E-17GA E-17-GB	E-17-AFQ E-17-AFR	I-70 westbound over Quebec Street I-70 eastbound over Quebec Street	Removal and reconstruction Removal and reconstruction
E-17-AER	N/A	I-70 over Sand Creek	Existing bridge previously constructed
E-17-KR	E-17-AFS	I-270 over I-70	Removal and reconstruction

Existing Structure No.	New Structure No.	Structure Location and Description	Action
E-17-VD	N/A	I-70 over Havana Street	Bridge constructed under Havana Design Build Project
E-17-VE	N/A	I-70 over UPRR spur track (near Havana Street)	Bridge constructed under Havana Design Build Project
E-17-IQ	E-17-AFT E-17-AFU	I-70 westbound over Peoria Street I-70 eastbound over Peoria Street	Removal and reconstruction Removal and reconstruction

13.5.3 Geometry

All fill and cut slopes along the longitudinal axis of bridges with spill-through abutments shall not be steeper than 2:1. There shall be a two foot berm at the top of the slopes at the front face of abutments and a two foot minimum dimension from the top of this berm to the bottom of girder. Minimum vertical clearance of 16.5 feet (from travelled way and shoulders) shall be provided for all highway grade separations. Pedestrian bridges or Utility/irrigation structures over roadways shall provide a minimum vertical clearance of 17.5 feet. The minimum structure widths shall be as shown in the Structure Typical Sections as provided in Schedule 10B Contract Drawings.

13.5.4 Type

a. Bridge types are not restricted to those historically used by the Department. The Developer may propose other types and components and submit to the Department for Approval. The Department will make its assessments by taking into account, among other factors, as to whether the type has been accepted for general use by other transportation authorities and the Developer has demonstrated that the design of the bridge type and components will perform well under the Project's environmental conditions, including frequent freeze-thaw cycles, anti-icing and de-icing.

b. Experimental bridge types, timber bridges, masonry bridges, and structural-plate arches shall not be permitted.

c. Bridges shall incorporate as few joints and bearings as possible, be continuous over supports, not use intermediate hinges, and use integral or semi-integral abutments wherever possible.

d. Fracture critical bridges for highway traffic shall not be permitted.

e. Precast double tees or precast box girders without a cast-in-place deck placed on top shall not be permitted.

f. If not supplied in this Section, the Developer shall obtain structure numbers for new structures from the Department.

13.5.5 Inspection Access

a. All bridge superstructures, joints, and steel-reinforced elastomeric bearing pads with sliding surfaces and high load multi-rotational (HLMR) bearings shall be made accessible for long-term inspection and shall be designed and detailed for ease of replacement, including jack locations, and required jack sizes. The bridge shall be designed to withstand the loads and forces with the superstructure jacked.

b. Superstructures consisting of I-girders with exposed cross frames shall be made accessible with walkways, or by use of an A-40 inspection truck. All concrete or steel box girders with an inside depth of five feet or more shall be made accessible for interior inspection.

c. Superstructure of the Cover shall be made accessible through ceiling for inspection of all girders and bearings. All pretensioned precast concrete box or tub girders with access shall be provided with low-point drainage through the bottom slab.

d. Access doors shall be placed at locations that do not impact traffic under the bridge, and shall be located to be readily accessible from bridge inspection trucks. Where applicable, the door shall swing into the box girder. The minimum opening for access doors shall be two feet by three feet and locked by a single padlock with lock protector. Access holes, through diaphragms, shall have a minimum diameter of 2.5 feet. CDOT *Standard Structural Worksheet B-618-2* shows typical bottom-slab access-door details.

e. All access holes shall be accessible with ladders from the ground and shall not require access by use of the Department's A-40 inspection truck. Where access doors are provided above slope paving, cleats to support a ladder shall be provided in the slope paving. Location of access holes shall be submitted as part of the design submitted for Acceptance by the Department.

f. Box girders shall be protected from access by vermin.

13.5.6 Components

a. Bridge Rails and Pedestrian Railing

Bridge rails shall be provided on approach slabs. The Developer shall design and construct pedestrian fencing/railing in accordance with AASHTO *LRFD Bridge Design Specifications*. Bridge rails and pedestrian rails not separated from vehicular traffic by bridge rails shall be designed to meet TL-4 loading in accordance with AASHTO *LRFD Bridge Design Specifications*. Pedestrian railing attached to bridge rails shall be installed behind bridge rail face, or back side of bridge rail. Cover plates shall be used over breaks in the interior and exterior bridge rail, curbs, or sidewalks to provide structural and safety shape continuity across the joint in the bridge rail and to provide face-of-curb continuity across the joint in the curb for traffic loading at these breaks in bridge rail and curb.

b. Splashguards

A 36 inch splashguard shall be provided on both sides of the bridge for the span over the I-70 Mainline/cross street or for a minimum distance of 50 feet from the edge of the roadway. Splashguards shall be in accordance with CDOT *Worksheet B-607-3*.

c. Approach Slabs

i. Approach slabs shall be used on each new bridge and shall be a minimum of 20 feet in length measured along the centerline of the bridge. Approach slabs shall be separate from and fit between cantilevered wingwalls or retaining-wall wingwalls so that the approach slab can freely rotate about the abutment. Bridge rails with water stopper shall be connected to approach slabs. Bridge rails shall function as a barrier to keep water out of the joint between wingwalls or retaining walls and along the edge of approach slab. The approach slab, for highway bridges, shall be at least the same width as the bridge deck, and provide for expansion and contraction at the approach pavement interface where required. Approach slabs shall be anchored to the abutment.

ii. The design shall include an underdrain system beneath all approach slabs to reduce water in embankment fills at bridge abutments.

iii. The approach slabs shall be designed for differential settlement such that they will not produce a grade break that is noticeable to the user and shall not be more than one inch within one year of opening to traffic. The Developer shall implement ground-improvement techniques to the approach embankment subgrade, if necessary, to meet this requirement.

d. Decks

i. The Developer shall provide a minimum concrete deck thickness of eight inches, excluding cast-in-place decks.

ii. Open or filled grating decks, cast-in-place bare decks, and orthotropic decks shall not be permitted. Concrete decks designed by the simplified “Ontario”, or any empirical methods, shall not be permitted.

iii. Full-depth precast deck slabs shall require cast-in-place joint closures and post tensioning across joints and an overlay. Pretensioned, precast concrete deck forms shall be a minimum of three inches thick and have a full grout or concrete bearing. Full grout is defined as a one inch minimum thickness by two inch wide grout pad.

iv. Stay-in-place metal deck forms are permitted. If stay-in-place metal forms are used, the superstructure, substructure, and foundation shall be designed for an extra five psf minimum dead load applied to the superstructure.

v. Parallel bridges shall have a minimum one inch (four inch preferred) longitudinal gap between decks or parapets, or shall be tied together to make one structure.

vi. Permanent deck forms shall not be permitted between girders or stringers where the longitudinal deck joint is located. Permanent deck forms shall not be permitted for cast-in-place post-tensioned box girder or T-girder deck slabs, or cantilevered portions of decks. In order for the cast-in-place portion of concrete placed on top of the top flange of a precast double tee or precast box girder to be considered composite with the precast top flange, the minimum total laminated deck thickness shall be eight inches, the minimum cast-in-place thickness shall be 4-3/4 inches, and the top surface of the precast top flange shall be roughened.

vii. Minimum longitudinal steel in the top mat of cast-in-place decks shall be #4s at six inch spacing spliced to the negative-moment steel reinforcing.

e. Deck Joints

i. Deck design shall avoid or minimize joints in accordance with the guidelines in CDOT *Bridge Design Manual*. A minimum of zero to four inch joint shall be placed at the end of approach slabs or locations of expansion devices shall be approved by the Department. A minimum of two expansion devices shall be installed per each bridge.

ii. Joint design shall use strip seals such as D.S. Brown A2R400-SSA2, WABO SE400 Type A or equivalent product pre-approved by the Department with expected maximum four inch movement or modular joints for expected movements four inches or greater.

iii. Design and location of joints shall provide for maintenance accessibility and future replacement.

iv. Aluminum joints shall not be permitted.

v. Modular joints shall be tested for fatigue loading according to the National Cooperative Highway Research Program (NCHRP) *Report 402, Fatigue Design of Modular Bridge Expansion Joints*, or NCHRP *Report 467 Performance Testing for Modular Bridge Joint Systems*, as well as the provisions included in Chapter 14 of the AASHTO *LRFD Bridge Design Specifications*.

vi. Expansion devices shall be set to provide a smooth surface between the final grade into the device and the final grade out from the device. A smooth surface is defined as a maximum grade break, at 30 feet either side of the device, of 0.3 percent. To facilitate the proper placement of expansion devices, the tabular bridge geometry shall include a bent line for the expansion devices on a bridge or approach slab. Asphaltic expansion devices and asphaltic plug joints shall not be used for any new construction. Silicoflex preformed seals shown on worksheets shall not be used on new construction without Approval by the Department.

f. Overlays

i. The Developer shall provide an initial bridge deck overlay for all bridge decks. Overlays shall be three inch hot mix asphalt (HMA) over a waterproofing membrane or 3/8 inch polymer concrete for bridges. The HMA overlay with a waterproofing membrane shall be used on both the bridge deck and associated approach slab. Thin-bonded overlays, such as epoxy or polymer concrete, shall be used when widening an existing bridge with a bare concrete deck. The thin-bonded overlay will be applied to both the existing deck and the widened portion.

ii. Latex-modified overlays shall not be used.

iii. The I-270 over I-70 Mainline bridge shall be constructed with either a three inch stone matrix asphalt (SMA) with waterproofing membrane overlay or a minimum 0.75" polyester concrete overlay.

g. Superstructures

i. Superstructures shall meet the requirements for redundancy, fatigue, crack control, and deflection in AASHTO *LRFD Bridge Design Specifications*.

ii. Field connections shall not be welded, but shall be made with high-strength bolts. Slip-critical connections shall be made with 3/4 inch, 7/8 inch, or one inch diameter, ASTM A325 bolts.

iii. The use of pins and hangers shall not be permitted. Category D or poorer weld details shall not be permitted in tension zones subject to fatigue stress ranges.

iv. The design shall clearly identify the location of all fracture critical members (FCM) and shall follow the procedures specified in the Applicable Standards and Specifications for identification of and requirements for FCMs.

v. The Developer shall follow the Shop Detail Drawing Review/Approval Guidelines developed by the AASHTO/National Steel Bridge Alliance (NSBA) Steel Bridge Collaboration G1.1-2000 for preparation of steel shop drawings.

h. Bearings

i. The Developer shall design and locate bearings to allow maintenance accessibility and future replacement. Substructure drawings shall show locations for lifting when removing bearings. If design loadings allow, elastomeric pads and steel-reinforced elastomeric bearings with or without sliding surfaces shall be used. Sliding surfaces shall be polytetrafluoroethylene (PTFE) with a stainless-steel mating surface. Bearings shall be either elastomeric pads (CDOT Type I), steel-reinforced elastomeric bearings, with or without PTFE and stainless steel sliding surfaces (CDOT Type I or Type II), or HLMR bearings (CDOT Type III). The thickness of Type II bearings shall be designed so that the acceptable shear-deflection limits of the pad are not exceeded if, for some reason, slip does not occur. The design of elastomeric pads and steel-reinforced elastomeric bearings shall be such that pad walk-out will not occur by including pad-walkout restraints. Sole plates, when used, shall have a 3/4-inch minimum thickness.

ii. At expansion bearings, the edge of the sole plate shall not slide past the edge of the elastomeric pad, by the use of a positive stop.

iii. At least three inches of cover shall be provided between anchor bolts and the edge of the concrete pedestal. Reinforcement for pedestals shall be greater than three inches high.

iv. Suppliers of bearings devices shall be selected from the Department's Preapproved Product List. Only one bearing type shall be used across the width of the bridge at any given substructure location. Elastomeric pads and steel reinforced elastomeric

bearing devices shall not be mixed with HLMR bearings at any one particular bridge. The minimum HLMR bearing height shall be seven inches.

i. Piers and Pier Caps

i. Aesthetic treatments on piers shall extend below finished grade and be considered for the Ultimate design as necessary to accommodate future construction of the I-70 Mainline and adjacent ramp improvements.

ii. Drop caps or integral caps are acceptable. Integral caps are preferred with cast-in-place or precast concrete box section systems. The use of integral steel pier caps shall be kept to a minimum.

iii. The design shall include provision for inspection access for integral steel pier caps.

j. Abutments

i. The design shall include integral or semi-integral, end-diaphragm-type abutments for bridge structures whenever possible. Mechanically stabilized earth (MSE) walls may serve as abutment support for bridge superstructure loads. Abutment supported by MSE shall be Geosynthetic Reinforced Soil Integrated Bridge System. Retaining-wall wingwalls may be used in lieu of cantilevered wingwalls at abutments for all aesthetic categories of bridges. The length of cantilevered wingwalls and/or retaining walls from the end of the abutments of a U-type abutment shall be four feet longer than the point of intersection of the embankment slope with the roadway finished grade.

ii. Backfill behind the abutments shall be as shown in the CDOT *Bridge Structural Worksheets* Backfill Drawings B-206-F1 or B-206-M1.

iii. Flow fill is allowed behind the abutments.

k. Slope Protection

The design shall include concrete slope protection for all slopes under bridges and on slopes between tiered walls. Slope protection on slopes between tiered walls and any slopes from shoulder to the top of retaining wall shall use similar detail.

l. Foundations

i. Differential settlement shall not exceed 1/2 inch within a bent or abutment; and span length in (feet)/400 differential settlement between adjacent bents or abutments.

ii. The Developer's Quality Management Plan (QMP) shall include inspection of all drilled caisson operations using non-destructive testing for non-redundant (single shaft) drilled caissons. Cross sonic log (CSL) or impact echo are acceptable methods of non-destructive testing for drilled caissons. Alternative methods proposed for non-destructive testing shall comply with Applicable Standards and Specifications. All drilled caissons while placing concrete shall have a depth vs. volume plot to monitor caving.

iii. Dynamic monitoring of driven-pile foundations using the Pile Driving Analyzer (PDA) tests shall be performed at a minimum of two piles per structure, each at a separate foundation element (abutment or pier foundation), and a minimum of two percent of driven piles to verify that pile capacity, with appropriate resistance factor, meets or exceeds the design-factored load per pile. The PDA tests shall cover pile size, hammer type, and geology condition changes for structures. The PDA tests shall include the measurements for initial driving and re-strike. The Developer may replace or supplement PDA tests with static load tests for piles. Static load tests shall be in accordance with ASTM D-1143 or ASTM D-3996. The exact number, type, layout and location of static and PDA tests shall be per the Developer's QMP. Static axial load tests or PDA on driven piles shall be performed in locations where driven piles will be used and the vertical loads will control the depth of the driven piles. PDA

testing criteria including number, type, layout, and location shall be submitted to the Department for Acceptance.

m. Drainage

i. Gutter flow at both ends of bridges shall be intercepted. Stormwater flowing toward the bridge shall be intercepted prior to the expansion device of the approach slab. Stormwater flowing away from the bridge shall be intercepted prior to leaving the approach slab. Backup drainage plan between girder and abutment/pier underneath the expansion device shall be provided. All stormwater shall be directed to an appropriate outfall. Permanent erosion protection shall be designed and installed at all outfall locations to prevent the occurrence of erosion. Outfalls shall have a well-defined and protected flow path.

ii. All bridge deck-drain inlets shall be grated. The bridge deck drainage system shall be compatible with the structural reinforcement, components, and aesthetics of the bridge. Outfalls shall be positioned to avoid corrosion of structural members, and splash on vehicular traffic and pedestrian areas below the bridge. Downspouts for bridge drains shall be minimum 10 inch diameter galvanized steel pipe, and shall meet the requirements of ASTM A53, Grade B, and Standard Weight Schedule 40. Downspout 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. Cleanouts shall be provided for downspout systems.

iii. Bridge deck drains shall be located so that downspouts can be taken immediately down pier columns. Bridge drain systems with “horizontal” runs shall not be used unless Approved by the Department.

iv. The bridge deck drain system shall be designed and constructed to be easily modified to accommodate future changes to the median width on the bridge. Downspout and outfall locations shall be located such that no changes are required in the future to accommodate the Ultimate design of the I-70 Mainline and adjacent ramp improvements. The bridge deck drain system shall be designed and constructed not to form icicles under the bridges.

n. Utilities

i. The Developer shall identify, maintain, and coordinate all Utility location on structures. Hanging of Utilities shall not be permitted under deck overhangs or on bridge rail. Protection of the pipes from the settlement of the abutment backfill shall be provided. The Developer shall resolve conflicts between Utilities and proposed structures in accordance with Schedule 10, Section 4 Utilities. A pull box shall be provided for access.

ii. Details of Utilities to be placed on structures shall be included as part of the design submittals to the Department. Utilities not hidden from view in superstructure elevation shall not be permitted. Bridge deck drainage or anti-icing pipes shall not be allowed inside of box girders or embedded within concrete structural members.

iii. The Department has identified two Utility structures, as specified in Table 13-2. Proposals for any additional Utility structures shall be submitted to the Department for Approval.

o. Median

The concrete curb and median cover material on the bridge deck and approach slabs shall be constructed to allow removal and modification in the future without causing damage to the bridge deck concrete and reinforcement.

p. The protecting of bridge Elements and roadway/pedestrian areas from bird droppings shall be considered in the design. The Developer shall eliminate all potential pigeon roosting and nesting areas and/or install various control systems, such as plates, grating, nets, spikes, electric systems, and wires as Approved by the Department at bearing areas, abutment and pier caps, and areas above pedestrian traffic. Bird control and nest removal shall be taken into consideration when planning long-term maintenance.

13.6 Cover

13.6.1 The Cover shall be designed for the landscaping features as specified in the Cover Landscaping Plans, as provided in the Reference Documents.

13.6.2 The Cover shall meet all requirements as described in Schedule 10, Section 4 Utilities, Section 12 Cover MEP System, Section 14 Landscaping and Aesthetics, Section 16 ITS and Tolling Equipment, and Schedule 10B Contract Drawings.

13.6.3 The pier wall shall be a solid concrete wall and extend beyond the ends of Cover, as specified in Schedule 10, Section 12 Cover MEP System.

13.7 Box Culverts

13.7.1 The Developer shall install box culvert structures as shown in Table 13-3 and shall submit to the Department for Acceptance.

Table 13-3 Box Culverts

Structure Description	Location
Offsite Outfall System	44th Avenue to South Platte River
Onsite Outfall System	Pond
Colorado Boulevard Ponds	Sta 2080+00
Stapleton Drive South Interception	Safeway Distribution Center

13.7.2 Design

a. New box culverts, replacements, extensions, and strengthening, including corresponding head and wingwalls, shall meet the requirements of Schedule 10, Section 8 Drainage. Culverts not covered in the CDOT *M & S Standards* shall be designed in accordance with AASHTO *LRFD Bridge Design Specifications*, CDOT *Bridge Design Manual*, and CDOT *Drainage Design Manual*. Thrust shall not be used.

b. All major box culverts, new and widening of existing, shall be load rated, documented and submitted to the Department, using the AASHTOWare BrR software.

13.8 Retaining Walls

13.8.1 All retaining walls on the Project shall comply with the Schedule 10, Section 14 Landscaping and Aesthetics. The Developer shall have sole responsibility for the type, material, performance and safety of temporary retaining structures.

a. Geometry

i. The retaining wall layout shall address slope maintenance above and below the wall and provide returns into the retained fill or cut at retaining wall ends where possible. Final tolerances shall be 1 to 200 for level and plumb. Any residual wall batter shall be into the fill. The Developer shall provide a traversable surface between the wall and the Right-of-Way (ROW) line for maintenance access.

ii. Walls that support soil and loads from outside ROW shall require an appropriate setback from the ROW line for the construction of the wall, permanent easement or a temporary construction easement shall be required. A system shall be provided to

intercept or prevent surface water from entering behind walls. Lengths of wall without relief joints shall be limited to lengths which control the differential settlement. A fence or pedestrian railing shall be provided at the top of walls over five feet high where access is open to the public or maintenance personnel.

b. Type

Metal walls, including bin walls and sheet-pile walls, recycled material walls, and timber walls shall not be permitted for permanent retaining walls. Wall types selected by the Developer shall have been used successfully in similar geotechnical locations and environmental conditions.

c. Design Requirements

i. All permanent retaining walls and their associated structural support elements constructed for the Construction Work shall be designed to resist corrosion or deterioration for the design service life. A drainage system shall be required for every wall type. MSE walls shall be designed in accordance with the requirements of AASHTO *LRFD Bridge Design Specifications*. All retaining wall installations shall include a positive drainage system of the backfill. The design of MSE and modular walls near or in bodies of water shall account for soft saturated soils and scour and shall prevent fines washout between facing elements. All walls near irrigation lines for landscaping shall account for any additional hydrostatic load due to a waterline break. All MSE walls with drainage lines placed within the strap zone shall account for any additional hydrostatic load due to pipe leakage. Utilities shall not be placed within the strap zone unless otherwise Approved by the Department. Retaining walls shall be designed according to the seismic criteria from AASHTO *LRFD Bridge Design Specifications*.

ii. Temporary retaining walls may be abandoned and left in place if not in conflict with any permanent elements of the Project and Ultimate design. Temporary retaining walls left in place must be completely covered by soil or construction material, so they are not visible.

d. Characteristics

i. MSE (Panel) Walls

A. Wall panels shall be constructed of reinforced concrete and provide corrosion protection for prestressing or post-tensioning steel. A mechanical connection to the wall facing shall be provided. Wall panels exposed to splash from traffic shall use epoxy coated reinforcing steel. Panel joints shall accommodate differential settlement.

B. The Developer shall use the FHWA *Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes - Volumes I and II*.

C. A barrier shall be provided to prevent fines washout between horizontal and vertical facing panel joints, panel wall construction joints, or relief joints.

ii. MSE (Block) Walls

A. A mechanical connection to the wall facing shall be provided. Friction connections relying on gravity alone are not permitted unless every course of block is connected to the MSE soil mass with a reinforcing layer. MSE block walls are not acceptable for walls at the bridge locations or for primary retaining walls. The Developer may use MSE block walls for secondary retaining wall locations, such as landscaping. The Developer shall make a list of proposed MSE block wall locations for Approval by the Department.

B. The Developer shall use the FHWA *Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes - Volumes I and II*.

C. A barrier shall be provided to prevent fines washout between horizontal and vertical block joints, block wall construction joints, or relief joints.

iii. Cast-in-Place Walls

Cast-in-place walls shall be designed and constructed in accordance with AASHTO *LRFD Bridge Design*. Construction-joint spacing shall accommodate or limit differential settlement. Structural diaphragm walls may be used when top-down construction is warranted.

iv. Anchored Walls

Design and construction shall use the following documents as guidelines: FHWA DP-90-068, FHWA RD-82-046, FHWA RD-82-047, Design Manual for Permanent Ground Anchor Walls FHWA RD-97-130, FHWA Geotechnical Engineering Circular No. 4-Ground Anchors and Anchored Systems IF-99-015. Anchors shall be encapsulated with plastic sheathing. Proof load tests for anchors shall be provided in accordance with the above FHWA guidelines.

v. Soil Nail Walls

Soil nail walls may only be used when top-down construction is warranted. Soil nail walls shall not be used if ground water seepage will be anticipated. Design and construction shall be in accordance with *AASHTO LRFD Bridge Design Specifications* and use the following documents as guidelines: FHWA *RD-89-186*, FHWA *Soil Nailing Field Inspectors Manual SA-93-068*, FHWA *Manual for the Design & Construction of Soil Nail Walls SA-96-069R*, FHWA *Geotechnical Engineering Circular No. 7-Soil Nail Walls NHI-14-007*. Load testing for nails shall be provided in accordance with the above FHWA guidelines. Final shotcrete surfaces shall be faced to meet the aesthetic requirements of the Schedule 10, Section 14 Landscaping and Aesthetics.

vi. Caisson Walls

Caisson walls may be used when top-down construction is warranted along areas where ROW or other obstacles are constraining, and alternatives such as soil nail wall construction is not feasible. Caisson walls shall be designed with a permanent concrete fascia, using cast-in- place or precast facing. Walls shall be designed and constructed in accordance with the AASHTO *LRFD Bridge Design Specifications*.

vii. Soil Reinforcement

Soil reinforcement for MSE and modular walls shall be galvanized or epoxy-coated steel, geogrids, or fabrics meeting creep requirements of AASHTO *LRFD Bridge Design Specifications*. The design shall account for any item projecting through the soil reinforcement. The Developer shall avoid placing culverts and Utilities perpendicular to soil reinforcement within the reinforced soil mass. Soil reinforcement shall be protected from corrosion of metal due to stray electrical currents.

13.9 Noise Walls

13.9.1 General

Noise walls shall be designed and constructed to the requirements as provided in the I-70 East EIS and Schedule 17 Environmental Requirements. Noise walls shall be designed in accordance with AASHTO *LRFD Bridge Design Specifications*. Final tolerances shall be 1/8 inch in one foot for level and plumb. The design of noise walls shall provide for adequate surface drainage. When the installation of a noise wall interferes with the access to existing, or proposed fire hydrants, the noise wall installation shall include fire hose access openings and associated identification signs. Location and demand for these openings shall be established in cooperation with the local fire department.

13.9.2 Geometry

When placed behind guardrail, noise walls shall be offset according to AASHTO *A Policy on Geometric Design of Highways and Streets*. The Developer shall place noise walls on top of concrete guardrail when offset space is limited to 10 feet or less.

13.9.3 Design Requirements

a. Panels

Panels shall be constructed of concrete. Panels may be cast-in-place or precast. Panels on bridges shall be cast-in-place concrete and jointed from longitudinal structural elements of the bridge. Panel design and construction shall consider future replacement and/or repair, and shall limit the risk from falling debris resulting from traffic impacting with the noise wall. The Developer may propose other types and components and submit to the Department for Approval.

b. Posts

Posts shall be reinforced concrete, prestressed concrete, or galvanized and painted steel.

c. Foundations

i. Foundations shall be posts set in concrete, flowfill, caissons, cast-in-place, or precast reinforced concrete footings. The bottom of all spread footing foundations shall be placed a minimum of three feet below finished grade. Reinforcing steel projecting into the above ground portion of walls, subject to splash from the roadway (areas within 10 feet horizontally of the edge of travel lane), shall be epoxy coated.

ii. All structures with concrete surfaces, including those accessible by graffiti vandals, shall have a surface treatment of concrete stain. This includes all retaining walls, noise walls, concrete roadway/bridge barriers, and slope protection.

13.10 Sign Structures

13.10.1 General

a. The Developer shall remove all existing sign structures per the limits as defined in Schedule 10, Section 11 Signing, Pavement Marking, Signalization, and Lighting. Static sign structures and supports meeting the geometric and sign layout requirements shown in the CDOT *M & S Standard Plans*. For static sign structures and supports that do not meet the geometric and sign layout requirements shown in the CDOT *M & S Standard Plans*, the structure shall be designed and constructed in accordance with the latest AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. Use Fatigue Category I for overhead sign structures. Sign structures shall be galvanized structural steel (single) tubing.

b. Variable Message Signs (VMS) shall be mounted on a sign bridge. The Developer shall prepare a structural design for each VMS structure in accordance with above specified AASHTO requirements and provide to the Department for Acceptance.

c. All sign structures shall include hand holes on poles for addition of future lighting.

d. The Developer shall provide minimum vertical clearance for static and dynamic sign structures in accordance with Schedule 10, Section 11 Signing, Pavement Markings, Signalization, and Lighting.

e. Components

i. Foundations

Drilled caissons shall be used to support overhead and cantilever sign structures. The Developer shall prepare one Project Foundation Report for all sign structures for

Acceptance, and shall have one foundation boring near each single caisson supporting monotube sign supports.

ii. Connections

Shop splices shall be made with full-penetration butt welds. Base connections shall be made with full-penetration shop butt welds. All sign connection hardware shall be galvanized, with strengthened structural tubing at electrical connection openings.

iii. Bridge-Mounted Signs

The Developer shall not mount signs on bridges.

13.11 Submittal Requirements

13.11.1 Structural Concept Reports and Plans

The Developer shall submit a Structural Concept Report and Plans to the Department for Acceptance, for each bridge and retaining wall. Submittal contents shall include:

a. Elevation views and cross sections depicting structure components. Also provide a maximum two-page description of type, materials, and design-life considerations for each proposed structure;

b. For retaining walls, the Developer shall submit:

i. A description of each wall type utilized on the Project;

ii. A description of methods of accommodating settlement and differential settlement;

iii. A description of the type of foundation for each type of wall; and

iv. The location of walls and identification of wall type.

c. Description of conceptual solutions for complex structural problems identified by the Developer;

d. Description of creative or innovative ways the design, construction, and/or choice of structural types will benefit and/or enhance Project Schedule, quality, aspects of the Construction Work, and minimize traffic impacts;

e. Provide Structure Concept Plans, for Acceptance by the Department, including:

i. Plans, elevations, and appropriate typical sections for each bridge type;

ii. Plan views of the structure identifying each bridge location and type. Include documentation of design vehicle turning movement analysis;

iii. Plan views of the structure identifying each wall location and type;

iv. Plan and details for the location and type of expansion joints for the interaction between the Cover and the adjoining infrastructure to include, but not be limited to, sidewalks, roadways, paths, landscaped areas, parking lots, and school facilities; and

v. Structure numbers for major structures.

f. Non Historically Used Bridges and Retaining Walls

For bridge types and retaining walls not historically used by CDOT, the Developer shall submit, for Approval by the Department:

i. A minimum one-page description of each bridge type (or foundation type) and retaining wall not historically used by CDOT; and

ii. A list of the transportation authorities that have used the proposed bridge type and retaining wall (include actual projects, application, performance, and references).

13.11.2 Preliminary (30% Level) Plan Package

Completed general layout drawing(s) shall be submitted for each major structural element. The final geometry and proposed structural type shall have been finalized and shall be shown and detailed in the Developer's drawings. Aesthetic requirements shall have been identified and incorporated into the Developer's drawings. Additional soil borings (if required) shall have been identified and the foundation system shall be shown in the Developer's drawings.

13.11.3 Final (100% Level) Plan Package

The independent design check shall have been completed and the original final structural design calculations shall be revised and corrected based on comments from the independent design check. Aesthetic details shall have been incorporated into the Developer's drawings. All changes or revisions resulting from in-process design progress review meetings, as described in Schedule 8 Project Administration, shall be incorporated.

13.11.4 Release for Construction

Copies in PDF and MicroStation electronic format files shall be made of all plans for all structures and submitted to the Department on computer disk (DVD) format. Falsework and shoring plans shall be signed and sealed by a professional engineer licensed in the State of Colorado.

13.11.5 Shop Drawings and Working Drawings

The Developer shall submit shop drawings and working drawings for each structure in accordance with Table 105-1 of the CDOT *Standard Specifications*. Shop drawings and working drawings shall be reviewed and approved by the Developer's professional design engineer.

13.11.6 Documentation

The Developer shall submit original design calculations, design-check calculations, and the rating Documents, in PDF format, to the Department as part of the Release for Construction package. A hard copy of certificate letter and a final detail letter shall be also included. As part of the submittals provide the following:

a. Design and design-check calculations shall have pages numbered and include a table of contents;

b. All calculations shall identify which code is utilized, and reference the appropriate section in the right-hand column;

c. References shall be included in the calculations to computer programs used to do the calculations;

d. Computer documentation shall include the following: name of program, vendor, version, and release date; record of software output and verification of output with manual calculations or other recognized program; clear identification of input and output values and meaning; and check of input; and

e. All calculations shall be signed and sealed by the Developer's Engineer.

13.11.7 Revisions to Release for Construction Documents and As-Builts

a. As a condition of Final Acceptance, the Developer shall submit to the Department on computer disk (DVD) format; changes to Release for Construction Documents, As-Built Drawings, and CADD files of the following documents for each structure:

   i. Design and design-check calculations;

   ii. Rating packages;

   iii. Rating files; and

   iv. As-Built Drawings.

13.12 Deliverables

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the specified time frames:

Table 13-4 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Bridge Removal Plan	Acceptance	Prior to RFC Documents
Structure Concept Report and Plans	Acceptance	Prior to proceeding with the design plan packages
Proposed bridge, foundation, or wall types not historically used by CDOT	Approval	Prior to proceeding with the design plan packages
Maintenance plan for each bridge type and box culvert structure type used	Acceptance	Prior to RFC Documents
Proposed locations of access holes	Acceptance	Prior to RFC Documents
Project Foundation Report	Acceptance	Submitted as part of the Preliminary Design Package and/or In-Process Design Packages
PDA testing criteria including number, type, layout and location	Acceptance	Prior to RFC Documents
Structural design for each sign structure	Acceptance	Prior to RFC Documents
Alternative Non-Destructive methods for testing non- redundant drilled caissons	Acceptance	As required
Design calculations and design-check calculations	Acceptance	Prior to RFC Documents
Load rating for box culverts	Acceptance	Prior to RFC Documents
Load rating for bridges	Acceptance	Prior to RFC Documents
VMS structural design	Acceptance	Prior to RFC Documents
As-Built documents	Acceptance	Prior to Final Acceptance.

13.13 Appendices

Appendix A Project Special Provisions

Appendix A
Project Special Provisions

The following specifications modify and take precedence over the Standard Specifications. The provisions of Appendix A to Schedule 10A Applicable Standards and Specifications apply to these Project Special Provisions.

PROJECT SPECIAL PROVISIONS

REVISION OF SECTION 202
REMOVAL OF EXPANSION DEVICE

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

Subsection 202.01 shall include the following:

This work shall consist of removing existing bridge expansion devices at locations shown on the plans in accordance with the applicable portions of Section 202 of the Standard Specifications or as amended by these Special Provisions and in conformity with the plans or as directed.

Subsection 202.02 shall include the following:

Removal operations shall be coordinated with the stage construction shown on the plans, indicated in the Special Provisions, or as directed by the Engineer.

The methods and equipment used for the concrete removal shall be approved by the Engineer. The Developer shall take all steps necessary to avoid damage to all reinforcing steel designated to remain in place. Any reinforcing bars damaged by the Developer's operation shall be repaired or replaced.

Following the removal of the concrete, all exposed reinforcing steel to remain in place, shall be straightened as required and thoroughly cleaned to sound metal by sandblasting. Any structural steel (top of girders and top of diaphragms) damaged by the Developer during removal, shall be repaired at the Developer's expense. Exposed concrete surfaces within the removal limits shall be sandblasted to remove all fractured or loose particles in order to promote good bond with the new concrete.

REVISION OF SECTION 202
REMOVAL OF BRIDGE

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

Subsection 202.01 shall include the following:

This work consists of removal of the existing bridges at the following locations:

Structures to be removed

Structure Description	Structure No.
I-70 over Brighton Blvd	E-17-UY, E-17-US
I-70 Viaduct	E-17-FX
UPRR Bridge Over 46th Avenue	
Colorado Blvd over I-70	E-17-HU, E-17-HT
I-70 over Dahlia St	E-17-HY, E-17-HZ
I-70 over Holly St	E-17-HW, E-17-HX
I-70 over Monaco St	E-17-GC, E-17-GD
I-70 over Denver Rock Island Railroad	E-17-EW, E-17-DF
I-70 over Quebec St	E-17-GA, E-17-GB
I-270 over I-70	E-17-KR
I-70 over Peoria St	E-17-IQ

Bridge removal shall consist of the complete removal of all superstructure and substructure elements unless otherwise shown on the plans.

Subsection 202.02 shall include the following:

The removal of the existing bridge shall be performed in a safe manner.

When removal operations are located over a Railroad or in proximity to any live waterway, additional coordination with the Railroad or other agency, (United States Army Corps of Engineers (USACE), US Fish and Wildlife Service, US Forest Service, etc.) shall be required.

The Contractor shall submit a Bridge Removal Plan to the Engineer, for record purposes only, at least 20 working days prior to the proposed start of removal operations. This Plan shall detail procedures, sequences, and all features required to perform the removal in a safe and controlled manner. The Bridge Removal Plan shall be stamped "Approved for Construction" and signed by the Contractor. The Bridge Removal Plan will not be approved by the Department.

The Bridge Removal Plan shall provide complete details of the bridge removal process, including:

(1) The removal sequence, including staging of removal operations. Sequence of operation shall include a detailed schedule that complies with the working hour limitations.

(2) Equipment descriptions including size, number, type, capacity, and location of equipment during removal operations.

REVISION OF SECTION 202
REMOVAL OF BRIDGE

(3) Shoring that exceeds 5 feet in height, all falsework and bracing.

(4) Details, locations and types of protective coverings to be used. The protective covering shall prevent any materials, equipment or debris from falling onto the property below. When removal operations are located over or in proximity to any live waterway, Railroad, or pedestrian/bicycle path, additional width of protective covering sufficient to protect these facilities shall be required. Detailed methods for protection of the existing roadway facilities, including measures to assure that people, property, utilities, and improvements will not be endangered.

(5) Detailed methods for protection of live waterways including minimization of turbidity and sedimentation, and protection of existing wetlands.

(6) Detailed methods for mitigation of fugitive dust resulting from the demolition.

(7) Detailed methods for mitigation of noise resulting from the demolition operation.

(8) Details for dismantling, removing, loading, and hauling steel elements.

(9) Methods of Handling Traffic, including bicycles and pedestrians, in a safe and controlled manner.

A Pre-Removal Conference shall be held at least seven days prior to the beginning of removal of the bridge. The Engineer, the Contractor, the removal subcontractor, the Contractor's Engineer, and the Traffic Control Supervisor (TCS) shall attend the Pre-Removal Conference. The Bridge Removal Plan shall be finalized at this Conference.

The Contractor's Engineer shall sign and seal (1) and (3) listed above in the final Bridge Removal Plan. Calculations shall be adequate to demonstrate the stability of the structure remaining after the end of each stage of removal, before traffic is allowed to resume in its normal configuration.

The final Bridge Removal Plan shall be stamped "Approved for Construction" and signed by the Contractor. The Contractor shall submit a final Bridge Removal Plan to the Engineer prior to bridge removal for record purposes only. The Contractor shall not begin the removal process without the Engineer's written authorization.

Submittal of the final Bridge Removal Plan to the Engineer, and field inspection performed by the Engineer, will in no way relieve the Contractor and the Contractor's Engineer of full responsibility for the removal plan and procedures.

Work within Railroad right-of-way shall be in accordance with Section 107. For bridge removal over Railroads, including overhead wires, tunnels and underground facilities, bridge removal plans will be contingent upon the drawings being approved by the Railroad company involved.

Unless otherwise directed, the Contractor's Engineer need not be on site when bridge removal operations are in progress, but shall be present to conduct daily inspection for written approval of the work.

REVISION OF SECTION 202
REMOVAL OF BRIDGE

The Contractor's Engineer shall inspect and provide written approval of each phase of the removal prior to allowing vehicles or pedestrians on, below, or adjacent to the structure. The Contractor's Engineer shall certify in writing that the falsework, bracing, and shoring conform to the details of the final Bridge Removal Plan. A copy of the certification shall be submitted to the Engineer.

The Contractor's Engineer shall inspect the bridge removal site and report in writing on a daily basis the progress of the operation and the status of the remaining structure. A copy of this daily report shall be available at the site of the work at all times, and a copy of the previous day's inspection report shall be submitted to the Engineer daily.

The Contractor shall have all necessary workers, materials, and equipment at the site prior to closing any lanes to traffic to accommodate bridge removal operations. While the lanes are closed to public traffic, work shall be pursued promptly and without interruption until the roadway is reopened to traffic.

Removal of hazardous material shall be in accordance with Section 250.

The Contractor shall take all steps to avoid contaminating state waters, in accordance with subsection 107.25.

Should an unplanned event occur or the bridge removal operation deviate from the submitted bridge removal plan, the bridge removal operations shall immediately cease after performing any work necessary to ensure worksite safety. The Contractor shall submit to the Engineer, the procedure or operation proposed by the Contractor's Engineer to correct or remedy the occurrence of this unplanned event or to revise the final Bridge Removal Plan. The Contractor shall submit his Engineer's report in writing, within 24 hours of the event, summarizing the details of the event and the procedure for correction.

Before removal of the protective covering, the Contractor shall clean the protective covering of all debris and fine material.

Bridge removal may be suspended by the Engineer for the following reasons:

(1) Final Bridge Removal Plan has not been submitted, or written authorization has not been provided by the Engineer to begin the removal.

(2) The Contractor is not proceeding in accordance with the final Bridge Removal Plan, procedures, or sequence.

(3) The Contractor's Engineer is not on site to conduct inspection for the written approval of the work.

(4) Safety precautions are deemed to be inadequate.

(5) Existing neighboring facilities are damaged as a result of bridge removal.

Suspension of bridge removal operations shall in no way relieve the Contractor of his responsibility under the terms of the Contract. Bridge removal operations shall not resume until modifications have been made to correct the conditions that resulted in the suspension, as approved in writing by the Engineer.

REVISION OF SECTION 202
REMOVAL OF BRIDGE

The Contractor shall notify all emergency response agencies of the proposed removal work and any detours 24 hours in advance of work. This shall include the Colorado State Patrol, local Police Department, local Fire Department, all local ambulance services, and the Sheriff's Department, as appropriate.

All required traffic control devices, night time flagging stations, barricades and VMS signs shall be in place, with detours in operation, prior to the beginning of removal operations each day. Night work shall conform to the requirements of the MUTCD, Parts 1, 5, and 6.

Prior to reopening the roadway to public traffic, all debris, protective pads, materials, and devices shall be removed and the roadways swept clean.

Explosives shall not be used for removal work without the written approval of the Engineer.

Removal shall include the superstructure, the substructure, which includes the piers, the abutments and wingwalls, the bridge rail, and any approach slabs and sleeper slabs.

Removal of the substructure shall be taken down to at least 1 foot below the natural existing or future ground surface at the lowest point of interface with the abutment, unless otherwise approved by the Engineer. Holes resulting from substructure removal shall be backfilled with Structure Backfill (Class 2) to the adjacent existing grades.

All other materials removed from the existing structure shall become the property of the Contractor and shall be properly disposed of offsite at the Contractor's expense, unless otherwise stated in the plans.

Existing structures, facilities, and surrounding roadways shall not be damaged by the removal operations. Damage that does occur shall be repaired immediately at the Contractor's expense.

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, wingwalls, rail, curb, expansion devices, approach slabs, slope paving, retaining walls, drainage structures, 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 Developer shall submit to the Engineer details of the removal operations showing the methods and sequence of removal and equipment to be used.

All bridge rail shall be carefully dismantled and stockpiled at locations as designated. Haul for stockpiling shall not be paid for separately, but shall be included in the work. The Division will transport the material salvaged from the stockpile site to the maintenance yard. The Developer will be required to load the material salvaged on the Division's hauling equipment.

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.

REVISION OF SECTION 202
SANDBLASTING REINFORCING STEEL

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

DESCRIPTION

Subsection 202.01 shall include the following:

Sandblasting Reinforcing Steel shall consist of cleaning exposed reinforcing steel designated to remain in place following the removal of adjacent concrete and prior to placing new concrete in accordance with the applicable portions of Section 202 of the Standard Specifications or as amended by these Special Provisions or as directed.

CONSTRUCTION REQUIREMENTS

Subsection 202.08 paragraph 3 shall include the following:

Rust which may form on the reinforcing steel within seven calendar days following the accepted sandblasting, will not be cause for rejection of the steel.

When acceptable reinforcing steel is exposed to the elements for more than seven calendar days prior to encasement in concrete, adequate measures shall be taken by the Developer, as approved by the Engineer, to protect the steel from contamination or corrosion. Reinforcing steel contaminated as a result of the Developer's failure to provide adequate protection as stipulated herein, shall be re-sandblasted.

REVISION OF SECTION 210
REBUILD PORTIONS OF PRESENT STRUCTURE

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

DESCRIPTION

This work shall consist of chipping concrete to a minimum depth of 1/8 inch, sandblasting and applying a gel mortar to the damaged area and bring the structure to its original shape.

MATERIALS

The material, to be approved by the Engineer, shall be a cementitious, 2-component, fast-setting mortar that is formulated for application by trowel and is especially designed for repair of overhead surfaces.

CONSTRUCTION REQUIREMENTS

Removal and rebuild operations shall be conducted so that there will be minimum interference to traffic below the structures.

The affected areas shall be chipped to a minimum depth of 1/8 inch into existing concrete, all loose concrete will be removed, the area shall be sandblasted and the surface preparation shall be as the product literature describes.

The material shall not be installed in the work prior to the Engineer's approval.

Two copies of the product literature containing pertinent materials and installation of the product supplied on this project shall be furnished to the Engineer at least two weeks prior to the products' installation.

Any damage to portions to remain in place by the Developer in performing the work described above shall be repaired to the satisfaction of the Engineer at the Developer's expense.

REVISION OF SECTION 502
DRILLING HOLE TO FACILITATE PILE DRIVING

Section 502 of the Standard Specifications is hereby revised for this project as follows: Subsection 502.06 shall include the following:

When the plans call for drilled holes filled with slurry or mud made from clay or bentonite, the diameter of the drilled holes shall be at least two inches greater than either the pile diameter or the diagonal corner to corner measurement of the pile cross section, unless otherwise designated on the plans. Oversized holes due to sloughing, drifting, over-drilling, or other causes shall be filled with the accepted slurry or mud at the Developer's expense.

The following mixture will yield approximately 1.2 cubic yards of an acceptable slurry or mud:

50 lbs. dry bentonite powder

Approximately 125 gallons of water (or sufficient amount to make a pourable mix)

1 cubic yard of sand; (approximately 2800 lbs.) reasonably free of material larger than 1/2 inch.

The sand need not be clean. Local soil reasonably free of material larger than 1/2 inch may be substituted for the sand. Cement, lime, flyash, or other pozzolanic or highly alkaline materials shall not be added.

This mixture may be mixed by auger in the drilled hole, by paddle type mortar mixers, by portable or semiportable concrete mixers, or by drum type concrete mixer trucks.

If the mixture is placed or mixed in the hole prior to pile driving, the top two to three feet of the hole may be filled with loose local soil to prevent splashing of the slurry or mud.

REVISION OF SECTION 502
PILING BITUMEN COATING

Section 502 of the Standard Specifications is hereby revised for this project as follows: Subsection 502.01 shall include the following:

This work shall consist of furnishing and applying bitumen coating and primer to steel pile surfaces as required in the plans and as specified herein.

Subsection 502.02 shall include the following:

(a) *Bitumen Coating*. Canal Liner Bitumen (ASTM D-252l) shall be used for the bitumen coating and shall have a softening point of l90°F to 200°F, a penetration of 56 to 6l at 77°F, and a ductility at 77°F in excess of 1.4 inches.

(b) *Primer*. Primer shall conform to the requirements of AASHTO M116.

Subsection 502.11 shall include the following:

All surfaces to be coated with bitumen shall be dry and thoroughly cleaned of dust and loose materials. No primer or bitumen shall be applied in wet weather, nor when the temperature is below 65°F.

Application of the prime coat shall be with a brush or other approved means and in a manner to thoroughly coat the surface of the piling with a continuous film of primer. The purpose of the primer is to provide a suitable bond of the bitumen coating to the pile. The primer shall set thoroughly before the bitumen coating is applied.

The bitumen should be heated to 300°F, and applied at a temperature between 200°F to 300°F, by one or more mop coats, or other approved means, to apply an average coating depth of 3/8 inch. Whitewashing of the coating may be required, as deemed necessary by the Engineer, to prevent running and sagging of the asphalt coating prior to driving, during hot weather.

Bitumen coated piles shall be stored immediately after the coating is applied for protection from sunlight and heat. Pile coatings shall not be exposed to damage or contamination during storage, hauling, or handling. Once the bitumen coating has been applied, the Developer will not be allowed to drag the piles on the ground or to use cable wraps around the pile during handling. Pad eyes, or other suitable devices, shall be attached to the pile to be used for lifting and handling. If necessary, the Developer shall recoat the piles, at his expense, to comply with these requirements.

A nominal length of pile shall be left uncoated where field splices will be required. After completing the field splice, the splice area shall be brush or mop coated with at least one coat of bitumen.

Subsection 502.12 shall include the following:

REVISION OF SECTION 503
DRILLED CAISSONS

Section 503 of the Standard Specifications is hereby revised as follows:

Add Subsection 503.071 immediately following Subsection 503.07 as follows:

503.071 Cross-Hole Sonic Logging.

(a) *General Requirements.*

The nondestructive testing method called Cross-hole Sonic Logging (CSL) shall be used on drilled caissons for the bridge piers.

The testing shall not be conducted until 48 hours after the placement of all concrete in a caisson, and must be completed within 20 calendar days after placement on production drilled caissons. The Engineer may specify a longer minimum time if special retarders, mix designs, or other factors result in slower-setting concrete.

The CSL tests shall be conducted by an experienced independent testing organization retained by the Contractor and approved by the Engineer prior to testing.

The CSL tests measure the time it takes for an ultrasonic pulse to travel from a signal source in one access tube to a receiver in another access tube. In uniform, good quality concrete, the travel time between equidistant tubes will be relatively constant and correspond to a reasonable concrete pulse velocity from the bottom to the top of the foundation. In uniform, good quality concrete, the CSL test will also produce records with good signal amplitude and energy. Longer travel times and lower amplitude/energy signals indicate the presence of irregularities such as poor quality concrete, voids, honeycomb and soil intrusions. The signal will be completely lost by the receiver and CSL recording system for the more severe defects such as voids and soil intrusions.

Upon completion of CSL testing all water shall be removed from access tubes and any other drilled holes. After the CSL results have been evaluated, required repair of defects has been conducted and the repair has been evaluated with another CSL survey, the CSL tubes shall then be grouted at the direction of the Engineer with an approved prepackaged grout having a minimum compressive strength of 4000 psi.

(b) *Preparation for Testing.*

The greater of a minimum of four (4) CSL tubes or one (1) CSL tube per linear foot of the drilled caisson diameter, which maximum number of CSL tubes controls, shall be installed in each drilled caisson, equally spaced around the perimeter of the caisson at 90 degrees.

The CSL tubes shall be Schedule 40 steel with an inside diameter of 1 ½ inches. Galvanized steel will not be permitted. Substitution will not be permitted. Pipes shall have a round, regular internal diameter free of defects or obstructions, including any at pipe joints (all pipe joints shall be threaded without any couplings), in order to permit the free, unobstructed passage of a 1.35 inch diameter source and receiver probe. Tubes shall be watertight and free from corrosion with clean internal and external faces to ensure passage of the probes, and to provide good bond with the concrete.

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CSL tubes shall be fitted with a watertight shoe on the bottom and a removable cap on the top. The tubes shall be securely attached to the interior of the reinforcement cage with a minimum cover of 3 inches.

CSL tubes shall be installed in each caisson in a regular, symmetric pattern such that each tube is placed the maximum distance possible from each adjacent tube, with a spacing of 90 degrees around the perimeter of the cage as specified above or as shown in the plans. The tubes shall be as near to parallel as possible, and are typically wire-tied to the reinforcing cage every 3 feet, or are otherwise secured such that the tubes stay in position during placement of the rebar cage and concrete. The tubes shall extend from ½ foot above the caisson bottoms to at least 3-feet above the caisson tops. Under no circumstances shall the tubes be allowed to rest on the bottom of the drilled excavation. If the caisson top is sub-surface, the tubes shall extend at least 3 feet above the ground or water surface.

All joints in the tubes required to achieve full-length shall be made watertight. Care shall be taken during reinforcement installation operations in the drilled caisson hole so as not to damage the tubes. After placement of the reinforcement cage and prior to concreting the caisson, the tubes shall be filled with clean water as soon as possible (no later than 4 hours after placement of cage) and the tube tops capped or sealed to keep debris out of the tubes. Care shall be exercised in the removal of caps or plugs from the tubes after installation so as not to apply excess torque, hammering, or other stresses which could break the bond between the tubes and the concrete.

The Contractor shall submit to the Engineer for review the proposed CSL system including equipment schematics, material specifications, tube size, installation details, testing procedures, and joint connections at least 14 days prior to starting drilled caisson construction.

(c) *Typical CSL Test Equipment. Typical CSL test equipment consists of the following components:*

1. A microprocessor based CSL system for display of individual CSL records, analogdigital conversion and recording of CSL data, analysis of receiver responses and printing of CSL logs.

2. Ultrasonic source and receiver probes for 1-½ inches to 2-inch inside diameter pipe, as appropriate.

3. An ultrasonic voltage pulsar to excite the source with a synchronized triggering system to start the recording system.

4. A depth measurement device to determine and record depths.

5. Appropriate filter/amplification and cable systems for CSL testing.

(d) *CSL Logging Procedures*.

Before the placement of concrete, a minimum of one tube per caisson shall be plumbed and the tube length recorded, including a notation of the tube projection above the caisson tops. Information on

REVISION OF SECTION 503
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the caisson bottom and top elevations and/or length, along with construction dates shall be provided to the Engineer before the CSL tests.

CSL tests shall be conducted between the pairs of tubes encompassing the perimeter and the major diagonals. Testing shall be in accordance with ASTM D 6760. Additional logs shall be conducted at no additional cost to the Department in the event anomalies are detected.

The CSL tests shall be carried out with the source and receiver probes in the same horizontal plane unless test results indicate potential defects, in which case, the questionable zone may be further evaluated with angled tests (source and receiver vertically offset in the tubes). CSL measurements shall be made at depth intervals of 0.5 feet or less, and shall be done from the bottom of the tubes working upward to the top of each caisson. Probes shall be pulled simultaneously, starting from the bottoms of the tubes, over a depth-measuring device.

Any slack shall be removed from the cables prior to pulling to provide for accurate depth measurements of the CSL records. Any defects indicated by longer pulse arrival times and significantly lower amplitude/energy signals shall be reported to the Engineer, and further tests shall be conducted as directed by the Engineer to evaluate the extent of such defects.

Additional NDT methods may be used to evaluate possible caisson defects including Single hole Sonic Logging, Gamma-Gamma Nuclear Density Logging, 3D Tomography, and/or Surface Sonic Echo and Impulse Response tests.

(e) *CSL Testing Results*.

CSL results shall be presented to the Engineer in a report. The test results shall include CSL logs with analyses of:

1. Initial pulse arrival time versus depth

2. Pulse energy/amplitude versus depth

A CSL log shall be presented for each tube pair tested, with any defect zones indicated on the logs and discussed in the test report as appropriate.

Additional needed NDT results shall also be presented to the Engineer in a report format.

Copies of all data (written, electronic, etc.) obtained from the CSL and NDT inspections shall be submitted to the Department in an expedient manner. These submitted copies shall become the property of the Department.

(f) *Evaluation of CSL Test Results*.

The Engineer will evaluate the CSL and NDT (if needed) results within 7 days of receipt from the Contractor and determine whether or not the drilled caisson construction is acceptable. The concrete condition shall be evaluated using the methodology described in Section 20.2.1 of the FHWA Geotechnical Engineering Circular Number 10 (Publication No. FHWA-NHI-10-016

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Drilled Shafts: Construction Procedures and LRFD Design Methods, FHWA 2010). The Contractor shall provide consultants and/or personnel, on an as needed basis, who are experienced and competent performing the above NDT methods. If a defect is found by the additional NDT, then the cost of the additional NDT shall be the responsibility of the Contractor.

If the NDT records are complex or inconclusive, the Engineer may require coring in accordance with subsection 503.071(g) below, or excavation of the caisson to verify caisson conditions. If a defect is confirmed, the Contractor shall pay for all coring or excavation costs, including grouting of all core holes.

The acceptance of each drilled caisson shall be the decision of the Engineer, based on the results of the caisson integrity testing report(s), including caisson coring, and other information on the caisson placement. Rejection of a caisson based on the caisson integrity testing shall require conclusive evidence that a defect exists in the caisson which will result in inadequate or unsafe performance under expected loads.

In the case that any caisson is determined to be unacceptable, the Contractor shall submit a plan for remedial repairs to the Engineer for approval. Any modifications to the foundation caissons and load transfer mechanisms caused by the remedial action will require calculations and working drawings stamped by a Professional Engineer registered in the State of Colorado for all foundation elements affected. All labor and materials required to perform remedial caisson repairs shall be provided at no cost to the Department and with no extension of the contract time.

(g) *Core Drilling of Drilled Caisson Concrete.*

When directed by the Engineer, production drilled caissons that are determined to be unacceptable by the CSL tests shall be cored to determine the quality of the concrete. One core sample shall be taken from each defective caisson for the full depth of the irregularities and for three (3) feet above and below the irregularity.

Because it is desired to obtain a high percentage of core recovery for visual inspection and testing methods, equipment shall be as follows:

1. The core drill shall be in good condition and capable of delivering a smooth flow of power to the bit, both in rotation and down thrust. The pump shall be in good condition and of the positive displacement type. The pump shall be capable of delivering a minimum of 15 gallons of water per minute at 200 psi. It shall be equipped with a relief valve set to release at a maximum of 200 psi. It shall be equipped with a pressure gauge with range from 0 psi to 1,000 psi.

2. The drill shall be size HW or larger. The core barrel shall be size HW or larger, M series, double-tubed, with a chromed inner barrel. The diamond set bit for each hole shall be of best quality, new, and with a minimum of four waterways. The Engineer may require a new bit or replacement of the core barrel at any time inspection indicates excessive wear or loss of diamonds.

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3. The core drill machine shall be set so that the drill force will be exactly vertical and so there will be not more than five (5) feet of laterally unsupported drill rod between the bottom of the drill spindle (chuck) and the top of the caisson concrete when the hydraulic feed is in the up position.

   When longer laterally unsupported sections of drill stem are necessary, braced casing or rigidly braced guides must be used to prevent lateral whip.

An accurate log of cores shall be kept and the cores shall be placed in a suitable wooden crate and properly marked showing the caisson depth at each interval of core recovery. The cores along with two (2) copies of the coring log shall be turned over to the Engineer for inspection and testing.

Construction shall not proceed above the drilled caisson until the quality of the concrete in the caisson, as represented by the core samples, is determined to be acceptable and notification to continue construction is given by the Engineer.

If the quality of the concrete in a drilled caisson is determined to be acceptable, or after caisson remedial repairs are complete and accepted by the Engineer, the Contractor shall grout the core hole with an approved prepackaged grout having a minimum compressive strength of 4000 psi.

REVISION OF SECTION 504
CONCRETE PANEL FACING MSE WALL

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

Replace 504.27 with the following:

504.27 Panel Facing Acceptance and Rejection. In this subsection, a "panel" refers to either a concrete panel or a hybrid unit. Each of the following shall be considered a defect:

(1) Dislocated Panel. A dislocated panel is an individual panel or its corner located outward more than ¼ inch from the adjacent panels.

(2) Cracked Panel. A cracked panel is an individual panel with any visible crack when viewed from a distance equal to the wall height in natural light.

(3) Corner Knock Off. A corner knock-off is a panel with any missing facial corners or architectural edges.

(4) Substandard panel. Substandard panels are concrete panels installed in any wall segments that do not meet the certified values for compressive strength. Each substandard panel counts as one defect.

(5) Oversize Joints. Panels with oversize joints are two adjacent panels that do not meet the required values in subsection 504.07(f).

(6) Panels Failing the 10 Foot Straightedge Test. Straightedge test failures are joints that that deviate from even by more than ¼ inch when measured by placing a 10 foot straightedge across the joint.

Defects shared by two adjacent panels such as oversized joint, dislocated panel and panels not passing 10 foot straight edge test will be count as one defect.

In the completed wall, or completed portion of the wall the number of defects, as described above, in each 40 foot section (horizontal or arc length) will be counted. If there are defects, the number of defects in the 40 foot section will be considered for acceptance or rejection according to the table below. For panels with less than or equal to 3 in acceptance category, if the defects are repairable or the overall quality of wall can be improved, with the consent from the Engineer, the Contractor is required to repair for panel acceptance without any additional cost. A walkthrough inspection shall be made as requested by the Contractor before final payment.

No. of Defects in 40 Foot Section	< or = 3	> or = 4
% Of Price Reduction for that section	Acceptance	Rejection

When the number of defects exceeds 4, the entire wall or portions thereof shall be replaced.

REVISION OF SECTION 504
CONCRETE BLOCK FACING MSE WALL

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

Replace 504.27 with the following:

504.27 Block Facing Acceptance and Rejection. In this subsection, "block" refers to either a concrete block or a hybrid unit.

(1) A dislocated block is where the edge of an individual block is offset outward more than ¼ inch or placed with a vertical joint more than ¼ inch from the edge of adjacent blocks.

(2) A cracked block is an individual block with any visible crack visible in natural light from a distance equal to the wall height.

(3) A corner knock-off is a block with any missing facial corners or any side longer than ½ inch at the corner.

(4) Substandard blocks are concrete blocks installed in any wall segments that do not meet the certified values of compression strength, water absorption rate, or freeze/thaw cycles; substandard blocks include blocks actually in the wall for which the Contractor does not provide reports and certifications as required in subsection 504.12.

In the completed wall, or completed portion of the wall, if the number of defective blocks (cracked blocks, corner knock-off blocks, dislocated blocks, efflorescence or cement blemished blocks and substandard blocks) and blocks failing the straightedge test exceeds 6 percent of the total number of blocks in any wall segment of 40 foot horizontal or arc length. Rejection will be applied to that portion of the wall. For blocks subject to rejection, if the defects are repairable or the overall quality of wall can be improved, with the consent from the Engineer, the Contractor shall repair. A walkthrough inspection will be made as requested by the Contractor before final payment.

% of Defective Blocks (x) in 40 foot section	$x \leq 6$	$6 < x$
Acceptance or rejection	Acceptance	Rejection

The acceptance or rejection shall be determined by dividing the sum of all defective blocks by the total number of blocks in that portion of the wall. When this percentage exceeds 6 percent, the Engineer will reject the entire wall or portions thereof. The Contractor shall replace the rejected wall at his own expense.

REVISION OF SECTIONS 509 & 708
PAINTING OF ALUMINUM ACCESS DOORS FOR STEEL STRUCTURES

Sections 509 & 708 of the Standard Specifications are hereby revised for this project as follows:
Subsection 509.24 shall include the following:

Aluminum access doors shall receive a solvent cleaning to remove grease, oil, etc.

(SSPC-SPI) followed by a brush blast to provide a profile similar to the structural steel. The access doors shall receive one coat of primer as described in the Revision of Section 708.03.

Subsection 708.03 shall include the following:

If Alternate 1, Alkyd System, is to be used on the structural steel, the aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following the application of this primer, the doors will be painted the same as the structural steel (one field coat of primer followed by the top coat). Coating thicknesses shall be the same as specified for the structural steel.

If Alternate 2, Inorganic Zinc-Rich Polyurethane System, is used on the structural steel, the aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following application of the vinyl wash primer, the same polyurethane top coat as used on the structural steel shall be applied to the access doors (minimum 3.0 mils dry film thickness).

The manufacturer of the primer shall certify in writing, that the primer used is compatible with the cleaned aluminum access doors and the polyurethane top coat to be used on the structural steel.

REVISION OF SECTION 509
LOCK-PIN AND COLLAR FASTENERS

Section 509 of the Standard Specifications is hereby revised for this project as follows: Subsection 509.01 shall include the following:

High strength steel lock-pin and collar fasteners shall be used in unit #5N for all high strength bolts (those required to conform to the required to conform to the requirements of AASHTO M164 (ASTM A325)) specified.

Subsection 509.08 shall include the following:

The steel lock-pin and swaged collar fastener system shall conform to the materials, manufacturing, chemical composition and mechanical requirements (in full size tests) of AASHTO M164 (ASTM A325). The shank diameter and the bearing area under the head and swaged collar shall not be less than those provided by a bolt and nut of the same nominal dimensions prescribed in the requirements for "Heavy Hexagonal Structural Bolts" and for "Heavy Semi-Finished Hexagonal Nuts" given in ANSI Standard B 18.2.1 and B 18.22, respectively. Each fastener shall provide a shank body of sufficient diameter to provided tensile and shear strength equivalent to or greater than the bolt specified; shall have a cold forged head on one end of the type and dimensions specified, a shank length suitable for material thickness fastened, locking groves (all annular rings) on the opposite end. Each fastener shall provide a steel locking collar of proper size for shank diameter used, which by means of suitable installation tools, is cold swaged into the locking grooves forming a head for the grooved end of the fastener after the pull groove section has been removed. The steel locking collar (the collar shall be of the flanged type) shall be a standard product of an established manufacturer of lock-pin and collar fasteners. The pin shall be specifically marked to identify the manufacturer.

The fasteners after installation shall conform to the following hardness requirements:

Hardness Number

Brinell		Rockwell C
Min.	Max.	Min.	Max.
248	311	24	33

All washers shall be hardened steel washers conforming to the requirements of AASHTO M293 (ASTM F436). The washers shall be specifically marked to identify the manufacturer.

Pin proof load tests (ASTM F606 Method 1) are required. Minimum frequency of tests shall be as specified in AASHTO M164 (ASTM A325) paragraph 9.2.4.

Wedge tests on full size pins (ASTM F606 paragraph 3.5) are required. If pins are to be galvanized, tests shall be performed after galvanizing. Minimum frequency of tests shall be as specified in AASHTO M164 (ASTM A325) paragraph 9.2.4.

Subsection 509.13 shall include the following:

The Developer shall provide the engineer with:

1. Mill Test Reports for all mill steel used in the manufacture of the lock-pin, flanged collars and hardened washers. The Mill Test Reports shall indicate where (city and state) the steel

REVISION OF SECTION 509
LOCK-PIN AND COLLAR FASTENERS

was melted and manufactured. (All materials shall be of domestic origin as well as all subsequent processing.)

2. Mill Test Reports for all mill steel used in the manufacture of the lock-pin, flanged collars and hardened washers. The Mill Test Reports shall indicate where (city and state) the steel was melted and manufactured. (All materials shall be of domestic origin as well as all subsequent processing.)

3. The lock-pin and collar Manufacturer's Certified Test Report with the following:

The location where all of the lock-pin, collars and hardened washers were manufactured.

A statement that all the fasteners provided meet the requirements of this specification and the applicable requirements of AASHTO M164.

Results of the tests required in Subsection 509.08.

Delete subsection 509.28(d) and replace with the following:

All field connections shall be made with high-strength bolts which include direct tension indicators. Direct tension indicators shall be either washer type direct tension indicators, tension control bolts or high strength steel lock-pin and collar fasteners.

Subsection 509.28(f) shall include the following:

The Developer shall require a representative of the lock-pin and collar manufacturer to be on the project to train the steel erector's personnel in the proper installation of the fastener system. This representative shall be thoroughly familiar with the lock-pin and collar system and the required installation procedures and equipment.

Installation and tightening of each connection shall be done in the following manner:

Splice connections shall not be tightened until the entire continuous length of girder is in place on the substructure. One half the holes shall be filled with lock- pins and collars. Field splice elevations shall be verified prior to tightening. A hardened washer per ASTM F436 may be used under the pin head for joint thickness adjustment so that the installed fastener conforms to the Dimension "B", (See attached table).

Fasteners in all holes of the connection shall be initially brought to a snug tight condition (as defined in the attached table) progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize realization of previously tightened fasteners. The snug tight condition shall be verified on the calibration device prior to achieving the required final clamping force when testing for acceptance.

After all fasteners in the connection are snug tight, they shall be fully tightened, progressing systematically from the center most rigid part of the connection to its free edge.

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After installation and tightening is completed each installed fastener shall be pinged with a hammer for soundness. Loose or rejected fasteners shall be removed and replaced with a new fastener. Each fastener shall be visually inspected in accordance with the attached table.

Subsection 509.28(h) shall include the following:

The Developer shall provide a direct tension measurement device (Skidmore- Wilhelm Calibrator or an acceptable equivalent) for acceptance testing of the fasteners on the project and it shall have been certified by a testing laboratory within the last 6 months.

A representative sample (randomly selected by the engineer) of three fasteners of each diameter, length and lot shall be tested by the Developer in the tension measuring device.

The assemblies shall be snug clamped to approximately the value indicated in the following table prior to final clamping If any fastener fails to meet the required minimum tension (a pin tail brakes off before achieving the final clamping force) listed in the following table, the lot shall be rejected.

PIN DIAMETER (Inches)	SNUG CLAMPING(1) (Kips)	FINAL CLAMPING(2) (Kips)
3/4	5	29
7/8	7	41
1	9	54
1 1/2	14	108

1. Partially swaged collar, pintail still attached to pin.

2. Fully swaged collar, pintail pulled off.

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Section 509 of the Standard Specifications is hereby revised for this project as follows: Replace subsection 509.08 with the following:

High Strength Bolts. All bolts used in fastening structural steel connections shall conform to the requirements of AASHTO M 164 (ASTM A 325), commonly known as High Strength Structural Bolts (HS). Heavy Hex Structural or Tension Control Bolts with suitable Heavy Hex Nuts and Plain Hardened Washers shall be provided. Type 1 bolts shall be provided for painted and Type 3 bolts for weathering (AASHTO M 222) structural steel. The length of bolts shall be such that the end of bolt will be flush with or outside the face of the nut when properly installed. Sufficient thread shall be provided to prevent the nut from encountering thread runout.

When the plans require bolts for structural steel connections to conform to the requirements of AASHTO M 164M (ASTM A 325M), bolts shall be substituted as outlined in the following table:

AASHTO M 164M	AASHTO M 164
Bolt Diameter	Bolt Diameter, Inch
M16	5/8
M20	7/8
M22	7/8
M24	1

The hardness for bolt diameters of 1/2 inch to 1 inch inclusive shall conform to the following:

BRINELL		ROCKWELL C	
Minimum	Maximum	Minimum	Maximum
248	311	24	33

Bolt proof load tests (ASTM F 606, Method 1) and wedge tests (ASTM F 606) on full size bolts are required. Minimum frequency of testing shall be as specified in AASHTO M 164.

All nuts shall be Heavy Hex and conform to the requirements of AASHTO M 292 (ASTM A 194), heat treated grade 2H, or AASHTO M 291 (ASTM A 563), heat treated grade DH. Proof load tests of all nuts in accordance with the requirements of ASTM F 606 are required. Minimum frequency of testing shall be as specified in AASHTO M 291 or AASHTO M 292.

All washers shall conform to the requirements of AASHTO M 293 (ASTM F 436). Compressible-Washer-Type Direct Tension Indicators, if used, shall conform to the requirements of ASTM F 959.

Rotational capacity (Lubrication) tests are required and shall be performed on all bolt, nut, and washer assemblies by the manufacturer or distributor prior to shipment to the project. Washers are required as part of the test. The rotational capacity tests shall be performed in accordance with the procedure defined in AASHTO M 164 and the following:

(a) Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly.

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(b) A rotational capacity lot number shall be assigned to each combination of lots tested.

(c) The minimum frequency of testing shall be two assemblies per rotational capacity lot.

(d) The bolt, nut, and washer assembly shall be tested in a Skidmore- Wilhelm Calibrator or an acceptable equivalent device.

(e) The minimum rotation, from a snug tight condition (10% of the specified proof load), shall be:

1. 240 degrees (2/3 of a turn) for bolt lengths less than 4 diameters.

2. 360 degrees (1 turn) for bolt lengths greater than 4 diameters and less than 8 diameters.

3. 480 degrees (1 1/3 turns) for bolt lengths greater than 8 diameters.

(f) The tension reached at the above rotation shall be equal to or greater than 1.15 times the required installation tension. The installation tension and the tension for the turn test are shown below:

Diameter Inch	Installation Tension Kips	Turn Test Tension Kips
1/2	12	14
5/8	19	22
3/4	28	32
7/8	39	45
1	51	59

(g) After the required installation tension listed above has been exceeded, one reading of tension and torque shall be taken and recorded. The torque value shall conform to the following:

Torque = 0.25 PD Where:
Torque = Measured Torque (foot-pounds) P = Measured Bolt Tension (pounds)
D = Bolt Diameter (feet)

Bolts which are too short to be tested in the Skidmore-Wilhelm Calibrator may be tested in a steel joint. The Installation Tension requirements need not apply. The maximum torque shall be computed using a value of P equal to the Turn Test Tension.

Bolts, nuts, and washers (where required) from each rotational capacity lot shall be shipped in the same container. Each container shall be permanently marked with the rotational capacity lot number such that identification is possible at any stage prior to installation.

The Division's QA Inspector shall be provided with the following documents prior to shipment of structural steel to the project:

(h) Certified Mill Test Reports for all mill steel used in the manufacture of the bolts, nuts, and washers. The mill test report shall indicate where the material was melted and manufactured.

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(i) Certified Laboratory Test Reports for the following:

1. Bolt Hardness tests.

2. Bolt proof load tests.

3. Bolt wedge tests.

4. Nut proof load tests.

5. Rotational capacity tests.

Subsection 509.10 shall be replaced with the following:

Anchor Bolts. All anchor bolts with suitable hex nuts and plain hardened washers shall conform to the requirements of ASTM A 449 and shall be galvanized in accordance with the requirements of AASHTO M 232 (Class C) or zinc coated in accordance with ASTM B 695, Class 50.

Subsection 509.19(c) shall include the following:

Stiffeners shall not be mechanically forced into position.

Subsection 509.20(a) shall include the following:

Trapezoidal steel box girder fabrication:

1. The exterior web to flange welds on trapezoidal box members, in which the included angle is less than 90 degrees, shall be welded using the flux cored arc welding process (FCAW).

2. The interior web to flange welds, which have included angles greater than 90 degrees, may be welded by either the submerged arc welding process (SAW) or the flux cored arc welding process.

Subsection 509.21 shall include the following:

The field connections of all members (girders and diaphragms) of plate girder systems with a radius of less than 800 feet and steel box girder systems shall be assembled in the shop and the holes match drilled while the connections are assembled.

Shop assembly may be complete structure assembly or progressive structure assembly at the fabricator's option:

(a) Complete structure assembly shall consist of assembling all of the structural steel for the superstructure of the bridge.

(b) Progressive structure assembly shall consist of initially assembling part of two adjacent girder lines simultaneously. Each girder line shall consist of at least three girders. While blocked in position,

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the diaphragm and girder field splices shall be fitted and match drilled. At least one shop section shall be added at the advancing end of a girder line and the next girder line started before any section is removed from the rearward end.

All girders shall be oriente`d upright and blocked simultaneously in the position they will occupy on the bridge's substructure. All holes shall be drilled while the girders are blocked in this position. Marking holes to be drilled after the girders are moved is not allowed.

After the holes are drilled, all splice plates shall be positioned in their respective locations and pinned/bolted to demonstrate that the hole alignment through the multiple plate thicknesses is in accordance with the specifications. The Division's QA inspector shall be notified prior to disassembly to verify splice hole alignment. Verification of splice hole alignment shall not relieve the Developer of the responsibility for proper fit up of the structural steel.

Quality Control shall measure flatness of the bottom flange at the bearing area. The bottom flange shall conform to the requirements of the Subsection 509.19(j). The Developer's Quality Control Report shall list each bearing measurement.

Connecting parts assembled in the shop for field connections shall be match-marked, and two copies of a diagram showing each match-marked piece and defining how to use the marking system shall be provided to the Engineer 10 days prior to beginning structural steel erection.

The gap of abutting joints between members in a connection shall not exceed 3/8 of an inch.

Subsection 509.22 shall include the following:

The QA Inspector will perform Rotational Capacity and Verification Tests in accordance with the procedures outlined in the Report " High-Strength Bolts for Bridges" (Report No. FHWA-SA-91-031 May 1991, revised April 1992) on all lots used for shop connections.

Any rotational capacity lot that fails to conform to the requirements shall be rejected. Rotational capacity lots that fail may, at the Developer’s option, be reprocessed and submitted for retest.

Bolt assemblies shall be installed in accordance with the procedures defined in Report No. FHWA-SA-91-031 May 1991, as revised April 1992.

Delete subsection 509.24 (c) and replace with the following:

(c) *Paint System*. All structural steel, with the exception of weathering (AASHTO M 222), shall be painted with the two coat system defined in Subsection 708.03. Painting shall include a coat of primer on splice plates, faying surfaces of girders and diaphragms, and the interior surfaces of steel box girders. The primer and top coat shall be applied in the structural steel fabrication shop prior to shipment of the steel to the project site. The primer and top coat, color as defined in the plans, shall have a dry film thickness of 3.0 mils each. The Volatile Organic Content (VOC) of the paint shall not exceed 2.8 pounds per gallon (340 gm per liter). The QA Inspector shall be provided with a materials data sheet for all paint used on the project.

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Paint shall be stored, mixed, strained, and applied in accordance with the manufacturers application instructions. Quality Control inspections and tests shall be performed in accordance with the listed test. The Quality Control Inspector shall maintain a checklist of the pieces tested. Only deficiencies require measurement records. These records shall be forwarded to the QA Inspector.

The Developer shall perform the test procedure ASTM D 4285 once every four operating hours to assure the absence of oil and moisture in the compressed air lines used to blast and paint.

The profile of surfaces to be painted shall be tested once every 2000 square feet (185 square meters). The procedure shall conform to ASTM D 4417.

The thinner used shall be that indicated in the Manufacturer's Technical Data Sheet. No material shall be substituted without approval. The maximum volume used in dilution shall not exceed the amount specified in the Technical Data Sheet.

The dry film thickness shall be measured to the frequency and using the procedure listed in The Structural Steel Paint Council Specification SSPC PA-2, with exception of diaphragms, bearings, and ancillary items. Ten percent of internal diaphragms in box girders, external diaphragms on all bridge girders, and ancillary items shall be spot measured (average to three readings). The Quality Control Inspector shall maintain a checklist of the members tested.

Replace subsection 509.28 with the following:

509.28 Connections Using High Strength Bolts.

(a) *Field Connections*. Only Heavy Hex Structural Bolts with Compressible-Washer- Type Direct Tension Indicators or Tension Control Bolts conforming to the requirements of Subsection 509.08 shall be used in structural steel connections.

(b) *Bolted Parts*. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material. All joint faying surfaces, when assembled, shall be free of scale; dirt; burrs; drilling/cutting lubricants; other foreign material; and other defects that may prevent solid seating of the parts. Contact surfaces within joints shall be free of oil, paint (except primer coat), lacquer, or rust inhibiter.

(c) *Rotational Capacity and Verification Tests*. The Division will perform Rotational Capacity and Verification Tests in accordance with the procedures outlined in the Report " High-Strength Bolts for Bridges" (Report No. FHWA-SA-91-031 May 1991, revised April 1992) on all lots used for field connections. Any rotational capacity lot that fails to conform to the requirements shall be rejected. Rotational capacity lots that fail may, at the Developers option, be reprocessed and submitted for retest.

(d) *Installation*. Bolt assemblies of appropriately assigned lot numbers shall be assembled together when installed in a joint. Fasteners and contact surfaces of splices shall be protected from dirt, moisture, and oil at the project site. Only as many fasteners as are anticipated to be in`stalled and tightened during a work shift shall be taken from protected storage. Fasteners not used shall be returned to protected storage at the end of the shift. Fasteners shall not be cleaned of lubricant that

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is required to be present in as-delivered condition. Bolt assembly lots which are improperly stored, lack lubrication, or accumulate rust, dirt, or other contaminants shall be cleaned, relubricated, and submitted for retest as defined in Subsection 509.28(c).

Bolt assemblies shall be installed in and tensioned to the minimum tension specified in the following table:

Bolt Diameter Inch	**Required Minimum Bolt Tension Kips**
1/2	13
5/8	20
3/4	29
7/8	41
1	54

Bolt assemblies shall be installed in accordance with the procedures defined in the Report "High-Strength Bolts for Bridges" (Report No. FHWA-SA-91-031 May 1991, as revised April 1992.

(e) *Inspection*. The Developer shall provide an acceptable platform from which the Engineer can inspect the bolt tension and determine whether the work meets the specification requirements. The Engineer will inspect a sufficient number of fasteners to assure that the minimum bolt tension has been attained. All undertensioned bolt assemblies shall be brought into compliance.

(f) *Painting of Connections*. Structural steel connections in which all bolt assemblies have been satisfactorily tensioned shall be cleaned to remove the lubricant from the exposed portions of the fasteners and any other contaminants. The bolts and splice plates shall then be painted as defined in Subsection 509.24.

(g) *Repair of Painted Surfaces*. The Developer shall repaint “touch up”, all areas in which the paint has been damaged. Tie downs and dunnage shall be cushioned to protect painted surfaces during transit. Repainting shall include all damage incurred during transit, handling, erection of structural steel, and forming and casting the deck. Paint shall conform to Subsection 708.03. Repainting will not be measured and paid for separately, but shall be included in the work.

REVISION OF SECTION 509
WELDING

Section 509 of the Standard Specification is hereby revised for this project as follows: Subsection 509.20 shall include the following:

For field welding A7 steel, electrodes used shall be E7015, 16, 18, or 28.

For welding A7 steel with low-hydrogen electrodes by any process, the minimum preheat and interpass temperature shall be 150^0F for thicknesses of metal up to 1-1/2 inches.

Subsection 509.26 shall include the following:

The Developer shall not commence any field welding on the girders until the Division's Materials Branch has been notified and their inspector is on the site. The preheating process shall be approved by the Division's inspector.

Subsection 509.20(h) shall include the following:

Base metal shall be preheated to 150^0F on the surface prior to welding studs.

REVISION OF SECTION 513
BRIDGE DRAIN

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

DESCRIPTION

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

MATERIALS

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

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.

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 Division. 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 Developer 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.

REVISION OF SECTION 601
PAINTING OF ALUMINUM ACCESS DOORS FOR CONCRETE STRUCTURES

Section 601 of the Standard Specifications is hereby revised for this project as follows: Subsection 601.14(b)4 shall include the following:

Aluminum access doors shall receive a solvent cleaning to remove grease and oil (SSPC-SPI) followed by a brush blast.

The aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following the application of this primer, the doors will be coated with Structural Concrete Coating conforming to Revision of Section 601 Structural Concrete Coating.

The manufacturer of the primer shall certify in writing, that the primer used is compatible with the cleaned aluminum access doors and the Structural Concrete Coating to be used on the Structural Concrete.

REVISION OF SECTION 601
STRUCTURAL CONCRETE (GROOVED PATTERN FINISH)

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

Subsection 601.09 shall include the following:

An approved elastomeric form liner that will produce a grooved pattern finish shall be used in the designated portions of retaining walls. The form liner shall be furnished with a coating of an approved, non-petroleum base, factory-applied form release agent. After fastening the form liner to the form, an additional coat of manufacturer's recommended (only approved non-petroleum base may be used) form release agent shall be applied to the liner prior to and for each pour of concrete. Adjacent sections of the form liner shall be butted together to produce a good mortar tight joint. All grooves shall line up in the vertical direction. The form liner shall be securely fastened to the forms with staples or nails, or other approved methods.

Form ties shall be inserted through the form liner by cutting a cross-shaped slit in the liner. Prior to reuse of the form liner on adjacent wall sections, slits in the form liner that do not coincide with new tie spacing shall be sealed with a plastic tape which will adhere securely to the surface of the form liner.

The Developer will be responsible to assure that whenever any discontinuances of the grooved pattern, or whenever any lines interrupting or intersecting the grooved pattern, are called for on the plans, that the resulting lines, horizontal, diagonal, vertical or otherwise, are neat and true, and that the form liner is not unduly deflected in any direction, including the form liner at the interface between the form liner and any other interrupting or intersecting line.

Subsection 601.09(f) shall include the following:

Forms to which a form liner is to be attached shall not be treated with oil. Section 601.14(a) shall include the following:

A grooved pattern surface finish as designated on the plans shall be used on the designated portions of concrete walls.

The Developer shall furnish samples at the job site measuring 4 feet by 10 feet for approval, at least two weeks prior to use. The final samples must receive the Engineer's written approval before the finish can be incorporated into the work. These samples are to remain undisturbed on the project until project acceptance.

For all walls or panels requiring a grooved pattern on the exposed surface which are less than 10 feet in height, the form liner producing the pattern shall be one continuous piece extending the full height of the wall or panel. For all other walls, no section of the form liner may be less than 10 feet in height except for one section which may be required to extend the form liner to full height.

Horizontal joints in adjacent form liner sections shall be offset by no less than one foot vertically. The form liners shall be properly aligned to limit visible horizontal and vertical joints in the concrete.

REVISION OF SECTION 601
STRUCTURAL CONCRETE (GROOVED PATTERN FINISH)

The required groove pattern finish shall extend from the bottom of wall or top of wall footing to the top of wall or bottom of wall coping or cap, or as otherwise shown on the plans. Grooves shall be continuous with no apparent curves or discontinuances. Variation of the groove from true vertical shall not exceed 1/4 inch for each 10 feet of wall height.

Concrete for such walls shall be poured monolithically vertically unless otherwise provided in the plans or permitted in writing by the Engineer. Concrete finish shall be in accordance with Revision of Section 601 - Structural Concrete Coating and shall be required for the full height of the grooved pattern finish to one foot below ground line.

Subsection 601.18 shall include the following:

Construction of grooved pattern surface finish on concrete walls will not be paid for separately but shall be included in the work.

REVISION OF SECTION 601
CONCRETE CLASS DT (DECK TOPPING)

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

Subsection 601.16 shall include the following:

Concrete bridge deck overlays shall be cured according to the Revision of Section 601, Bridge Deck Concrete.

Subsection 601.17 shall include the following:

In the event that plastic shrinkage cracking has occurred, any cracks greater than 0.010 inch in width that develop within the first 5 days of overlay placement shall be assumed plastic shrinkage cracks. The cracks will be measured by the Engineer by the insertion of a wire gage at any time or temperature at 5 days. The Developer shall make repairs by filling the cracks, concrete removal and replacement, or other methods approved by the Engineer at no additional cost to the project.

A low viscosity two-part methacrylate or approved equal shall be used to fill cracks in accordance with the recommendations of the manufacturer of the crack filling material.

Those portions of the structure that have been overlaid with the Concrete Class DT shall not be opened to traffic, including construction traffic, for at least 5 days after overlay placement and until the concrete has reached compressive strength f c'.

Subsection 601.19 shall include the following:

Saw-cutting and sealing construction joints in bridge decks shall be included in the work.

REVISION OF SECTION 607
CONCRETE MASONRY SOUND BARRIER

Section 607 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of constructing a Concrete Masonry Sound Barrier in accordance with the plans and specifications.

MATERIALS

(a) General. References to the International Building Code (IBC) shall refer to the latest Edition. Laboratory technicians involved in masonry testing shall be certified by the National Concrete Masonry Association as a "Certified Laboratory Technician for Concrete Masonry". Technicians shall possess records of certification at all times when on site, during sampling of materials, preparation of test specimens, and while conducting tests.

(b) Concrete Masonry Units. Concrete masonry units (CMU) shall conform to the requirements of ASTM C 90 and the following:

1. Provide units that are Type II (non-moisture controlled), hollow, and normal weight.

2. The compressive strength of CMU'S shall be as defined in ASTM C 90 or greater as required to attain f'm.

3. Units shall be integrally and uniformly colored as defined in the plans.

4. Units shall be the size and surface texture defined in the plans.

5. Provide an approved water repellent additive in accordance with the manufacturers recommendations.

6. The Developer shall sample and test CMU's in accordance with ASTM C 140 and provide the Engineer with complete test reports as outlined in Section 10 of C 140.

(c) Mortar. Mortar for concrete masonry construction shall conform to the requirements of the ASTM C 270 and the following:

1. Provide Type S in accordance with the Proportion Specifications for Portland Cement, lime, and sand. Masonry cement will not be allowed.

2. Quantities of sand, cement, and lime shall be accurately measured, shovel counts shall not be used.

3. Mortar shall be integrally and uniformly colored to match the CMU's.

4. Provide an approved water repellent additive in accordance with the manufacturers recommendations.

(d) Grout. Grout shall conform to the requirements of UBC Standard 21-19 and the following:

REVISION OF SECTION 607
CONCRETE MASONRY SOUND BARRIER

1. A 28 day compressive strength of 2000 psi or greater as required to attain f'm. The Developer shall sample and test the grout for every 5000 square feet of wall as construction progresses in accordance with the requirements of IBC Standard. Test reports shall be submitted to the Engineer as outlined in IBC.

2. Air is not required.

3. Up to 20% by weight of the cement may be an approved fly ash.

4. Fine aggregate shall conform to the requirements of AASHTO M 6 as defined in Section 703.

5. The coarse aggregate shall conform to the requirements of AASHTO M 43, Size 7 or 8, as defined in Section 703 and shall be a minimum of 50% of the total aggregate.

6. Sufficient water (or a combination of water and water reducer) shall be added to the grout to attain a slump of 8 to 10 inches prior to placement.

7. Provide an approved water repellent additive in accordance with the manufacturers recommendations.

(e) Prism Testing. The Developer is responsible for providing a concrete masonry assemblage (a composite of CMU's, mortar, and grout) with a strength, f'm, of at least 2000 psi. Prism tests shall be conducted by the Developer prior to starting and during construction to verify design compressive strength. Compressive strength of prisms shall be based on tests at 28 days and each set of prisms shall equal or exceed f'm. Compressive strength at seven days or three days may be used provided a relationship between seven-day and three-day and 28-day strength has been established for the project prior to the start of construction. Verification by masonry prism testing shall be as follows:

1. A set of five masonry prisms (grouted solid) shall be built and tested in accordance with IBC prior to the start of construction. Materials used for the construction of the prisms shall be taken from those specified to be used for the project.

2. A set of three prisms (grouted solid) shall be built and tested during construction in accordance with IBC Standard for each 5000 square feet of wall area, but not less than one set of three masonry prisms for the project. Prisms shall be constructed from materials randomly selected on the project site.

3. Test reports shall be submitted to the Engineer as outlined in IBC Standard.

4. Those portions of the wall represented by tested prisms that do not attain f'm shall be removed and replaced with a wall that meets the requirements of this specification at the Developers expense.

(f) Masonry Reinforcement. Reinforcing Steel (Deformed Bars) shall conform to the requirements of Section 602 and shall be Grade 60.

REVISION OF SECTION 607
CONCRETE MASONRY SOUND BARRIER

Joint reinforcement shall be provided every other coarse or as shown on the plans and shall be hot dipped galvanized in accordance with ASTM A 153-Class B-2, ladder type with 9 gage side and cross rods. Lap splices for joint reinforcement shall be a minimum of 6 inches.

1. Concrete Cap. Reinforcing Steel shall conform to the requirements of Section 602 and shall be Grade 60. Concrete shall conform to the requirements of Section 601 and the following:

2. Concrete shall be Class DT with a minimum cement content of 565 pounds per cubic yard.

3. Concrete shall be integrally and uniformly colored as defined in the plans.

4. The concrete cap can be either precast or cast-in-place.

(g) Water Repellent. An approved polymer water repellent shall be provided in all CMU's, mortar, and grout in accordance with the manufacturer's recommendations. The following polymer water repellent additives are approved:

Dry-Block by W.R. Grace.
Addiment Block Plus.

(h) Control Joints. Control joint material shall conform to the requirements of ASTM D 2000 2AA-805, ASTM D 1751 or as approved by the Engineer.

CONSTRUCTION REQUIREMENTS

General. Construction of the concrete masonry walls shall conform to the requirements of the International Building Code (IBC), the plans and specifications.

Sample Approval. The Engineer shall approve in writing the following before concrete masonry wall construction begins:

Color and texture of concrete masonry units.

Four weeks before construction begins provide the Engineer with two concrete masonry units of each color and texture required on the project.

REVISION OF SECTION 607
FENCE CHAIN LINK SPECIAL

Section 607 of the Standard Specifications is hereby revised for this project as follows: Subsection 607.02 shall include the following:

All materials shall meet the requirements specified in AASHTO M181 except as otherwise noted in the plans and these specifications. The Developer shall provide certification from the manufacturer that all materials used are in compliance with the requirements of the plans and these specifications.

All material shall be galvanized. When required by the plans the fence shall also be vinyl coated. The color shall be as noted in the plans. All exposed materials shall have a uniform coloration. Temporary members and attachments that are to be removed need not be vinyl coated. The inside of pipes shall not be vinyl coated. When the fence is vinyl coated bolts and nuts shall be either vinyl coated or painted to match fence coating. Anchor bolts, threaded rods, anchor studs, post dowels, and other unexposed portions of anchorage assemblies shall be galvanized and not vinyl coated or painted.

The Developer shall furnish to the Engineer for approval a 12" X 12" sample of the fabric (showing the exact coating and fabric construction to be used) and manufacturer's literature covering all aspects of the system he intends to install before ordering or fabricating any parts.

The fabric shall be AASHTO M181 Class C; or, when vinyl coating is specified in the plans, Class B. The mesh and wire sizes shall be as specified in the plans. When 10 mm (3/8") mesh with 12 gauge wire is specified in the plans the following properties shall apply.

For other mesh and wire sizes the properties shall be as specified by AASHTO M181.

Mesh	3/8" clear opening
Core wire breaking strength	650 lbs (minimum)
Core wire diameter	0.105 inch +/-0.005"
Galvanizing, Class C fabric	1.2 oz./sq. ft.
Galvanizing, Class B fabric	0.30 oz./sq. ft.
Vinyl Coating Class B Fabric	0.008 inch +/-0.002 inch

Tension wires shall be AASHTO M181 Type 1 Class 2; or, when vinyl coating is specified in the plans, Type 4.

Tension wires and their fittings shall have a minimum breaking strength of 1920 pounds.

Truss rods and their fittings shall have a minimum breaking strength of 3840 pounds for fences without horizontal members and with a minimum prestress force given by the plans.

Posts and horizontal members shall be standard or extra strong steel pipe, as noted in the plans, satisfying ASTM A53 Type E or S, Grade B (Fy = 35000 psi); or, at the Developer's option, ASTM A466 Grade D pipe (50000 psi) minimum yield strength) conforming to the following table may be substituted for both the standard and extra strong pipe of the same outside diameter

REVISION OF SECTION 607
FENCE CHAIN LINK SPECIAL

called for in the plans. All fittings and connections dependent on the pipe's inside diameter shall be modified as necessary for proper fit-up, as approved by the Engineer.

	Alternative Pipe		
Nominal Diameter In.	Outside Diameter In.	Lb. Per Ft.	Wall Thickness In.
1.25	1.660	1.836	0.111
1.50	1.900	2.281	0.120
2.00	2.375	3.117	0.130
2.50	2.875	4.640	0.160

Stretcher bars, truss rods, tension wires, post tops, and other required fittings and hardware shall be commercial quality steel, or better, or cast or malleable iron as appropriate to the article. A pair of two tension wires with appropriate turnbuckles or other adjustment devices, may be substituted for each truss rod.

Post clips, wire ties, or hog rings shall be galvanized 9 gauge or 14 gauge (before galvanizing) steel wire, and vinyl coated when specified by the plans. Wire ties shall be given at least one complete turn. Ends of wire ties shall be directed away from traffic.

Subsection 607.03 shall include the following:

For fences without permanent horizontal members and with a minimum prestress force given by the plans, the following shall apply.

The total pretension force in the tension wires and the mesh combined shall not be less than the value shown in the plans. Each tension wire, truss rod, and the mesh should have some pretension and shall not be slack. This is to assure the strength and stiffness of the fence system under the anticipated loads.

The Developer shall control the quality of the fence tensioning by checking that the deflection of the fence does not exceed the value shown in the plans when the test load described in the plans is applied. The Engineer may choose to assure this quality by observing these tests, or by performing tests of his own. If the deflection is excessive, the Developer shall retension the fence components.

The temporary horizontal members shall be removed after the tensioning of the fence is accepted.

REVISION OF SECTION 618
PRESTRESSED CONCRETE

Section 618 of the Standard Specifications is hereby revised for this project as follows: In subsection 618.04 replace the last sentence with:

The friction losses shall be determined in accordance with the plans and as provided for in the AASHTO LRFD Specifications for Highway Bridges.

Revise 618.06(b) 9 to read:

9. Copies of all concrete mix designs to be used, including mix design computations and test data, and acceptable specific gravities for mud balance tests, provided by the grout manufacturer.

Add 618.06(b) 14:

14. Post-tensioning system. Duct and anchorage inspection schedule, duct splices at closure pour inspection schedule, and duct pressure testing schedule, including name(s) of the of the responsible representative of the post-tensioning system supplier who will conduct inspections and testing.

Revise 618.06(c) to read:

Frequency. QC inspection and testing at all intervals of duct anchorage, duct splice operations, forming, tensioning, steel and concrete placement, curing, and storage operations shall be performed in accordance with the accepted QCP. The QCP shall contain provisions for increased frequencies of inspection and testing when operations or products do not conform to the Contract."

Add 618.06(d) 8:

8. Post-tensioning Ducts. The reponsible representative of the post-tensioning system supplier shall submit to the QA Representative a letter certifying that the ducts, duct splices, and anchorages are installed according to the Contract and that they have been inspected by the responsible representive of the post-tensioning system supplier and adequately held an air pressure test of 45 psi.

Revise 618.07(a)7 to include:

The presence of rust on strand shall not necessarily be cause for rejection. Light rust and rust that does not result in visible pitting of the prestressing steel with the unaided eye shall be acceptable. Prior to evaluation, rust shall be removed from representative lengths of prestressing strand by heavy duty scouring pads, such as Scotchbrite by 3M. After rust removal, visual comparisons shall be made to picture sets in the article "Evaluation of Degree of Rusting on Prestressed Concrete Strand" published in the 1992

May-June edition of the PCI Journal. Surface conditions comparable to picture sets 1 through 3 shall be acceptable, while surface conditions comparable to picture sets 4 and greater shall be cause for rejection of the prestressing strand.

REVISION OF SECTION 618
PRESTRESSED CONCRETE

Revise 618.07(c)(1)(4) to read:

(4) A grout manufacturer's field representative, who is a full-time employee of the grout manufacturer, will provide technical product assistance to the grouting crew, and will be present during start-up of grouting operations and be able to be present, at the request of the Engineer, should problems with the grout occur.

Revise 618.07(c)(1)(5) to include:

Be a full-time employee of the post-tensioning system supplier.

A holder of a current Grouting Training Certificate from the American Segmental Bridge Institute.

Revise 618.07(c) Item 9 of grouting plan to read:

9. Procedures for handling blockages, procedures and equipment required for flushing ducts of grout if necessary, and how and when it will be decided whether or not to flush ducts.

Add 618.07(c) Item 12 to grouting plan as follows:

12. List of production testing along with acceptable values. Subsection 618.07(c)2 (1) shall include:

Alternative anchorages must be submitted and approved by the Engineer prior to the bid date. Alternatives submitted after this date will not be accepted.

Subsection 618.08 shall include:

Permanent anchorage grout caps are required and shall be installed before grouting begins. Anchorage devices shall have a minimum clear concrete or grout coverage of 2 inches in every direction unless otherwise shown in the drawings.

Replace the second paragraph of Subsection 618.09 (a) with:

The time from installing the prestressing steel in the ducts in an unstressed condition to grouting after stressing shall not exceed thirty days. The exceptions to the thirty day grouting requirement is during cold weather when heating would be required to allow the ducts to be grouted in accordance with (e) below, or if it is anticipated that a duct may not been grouted within 30 days after installing the tendon strands in the duct the Developer will be allowed to place a 40 ft test strand into the sealed duct as a corrosion test strand that can be removed and evaluated for corrosion per subsection 618.08(a)7. If the test strand method is used the Developer shall install a test strand into a representative duct for each installation stage of tendons on the project. The test strand should pass through a local low point of the duct. If the Developer chooses not to heat the structure, and the ducts have not been grouted within thirty days of installation of the prestressing steel in the ducts, the ducts shall be grouted the first day weather permits in accordance with (e) below.

REVISION OF SECTION 618
PRESTRESSED CONCRETE

Subsection 618.09 (b) shall include:

The grout manufacturers lot definition in writing shall be included with the grouting plan. Table 618-1 Fluidity Test shall be revised as follows:

The minimum Efflux Time from Flow cone shall be 11 Seconds Minimum per ASTM C 939 test method.

The minimum Efflux Time from Flow cone shall be 5 Seconds Minimum per ASTM C 939 test method Footnote 3.

Revise Subsection 618.09 (d) to include:

Grouting. All grouting operations shall be performed under the immediate control of the representative of the post-tensioning system supplier.

The Developer shall perform, or contract a commercial testing entity experienced with the following tests, in the presence of the Inspector/Engineer, and report the results to the Engineer:

One pressure bleed test per day in accordance with the requirements of Appendix C of the "Specification for Grouting of Post-Tensioned Structures" by the Post-Tensioning Institute. The Gelman filtration funnel shall be secured vertically plump in a stand and shall be pressurized to 50 psi and the maximum percent bleed shall be zero when the vertical rise of ducts is greater than 6 ft, shall be pressurized to 30 psi and the maximum percent bleed shall be 2% when the vertical rise of ducts is greater than 2 ft and equal to or less than 6 ft, and shall be pressurized to 20 psi and the maximum bleed shall be 4% when the veritical rise of ducts is equal to or less than 2 ft.

Two mud balance tests per day or when there is a visual or apparent change in the characteristics of the grout in accordance with the API Recommended Practice 13B-1 "Standard Procedure for Field Testing Water-Based Drilling Fluids". Acceptable specific values for the grout shall be provided by the grout manufacturer and included with the grouting plan."

Replace the last sentence in Subsection 618.09 (d)(4) with: The efflux time shall be as shown in Table 618-1.

REVISION OF SECTION 618
SEGMENTAL PRESTRESSED CONCRETE STRUCTURES

Section 618 of the Standard Specifications is modified for post-tensioned elements for this project and replaced with the following:

Subsection 618.01 shall include the following:

This work shall consist of the construction of post-tensioned concrete members in accordance with these specifications and in conformity with the plan details.

This work shall include the stressing, furnishing and installation of any items necessary for the particular prestressing systems to be used, including but not limited to ducts, prestressing steel, anchorage assemblies, reinforcing for prestressing, and grout used for pressure grouting ducts.

The term "segment" refers to a modular section of the superstructure consisting of the cross-section detailed on the plans. The lengths of the segments are detailed on the contract plans.

The weight of each precast segment shall be as permitted for handling and transporting subject to Engineer's approval. The length of cast-in-place segments shall be the length between construction gaps shown.

The term "match cast" refers to a fabrication procedure whereby a segment is cast against the preceding segment. Match casting may be accomplished by either the short line casting method or the long line casting method.

Subsection 618.02 shall include the following:

All Duct splices shall use Shrink Sleeves or as approved by the Engineer. Subsection 618.03 shall include the following:

Post-tensioned members will be of the type, shape, and dimensions as shown on the plans.

The minimum strength of the concrete at the time of post-tensioning shall be 3500 psi or as given on the plans, whichever is greater.

Welds or grounds for welding equipment shall not be made on the forms or on the steel in the member after the prestressing steel has been installed, unless otherwise indicated on the plans.

The Developer will not be allowed to deviate from the erection method or erection sequence, as shown on the plans. However, the Developer may add temporary post-tensioning for purposes of erection or supporting construction loads.

The Developer may request and receive copies of all design information (calculations, computer output, etc.) submitted for this project. This request shall be made through the Project Engineer.

The Developer shall submit drawings and calculations for the construction loading, if any, to which the bridge will be subjected during construction. These drawings and calculations shall:

Be prepared by an Engineer who is thoroughly knowledgeable in the design of post-tensioned concrete bridges.

REVISION OF SECTION 618
SEGMENTAL PRESTRESSED CONCRETE STRUCTURES

Be in accordance with the current edition of the AASHTO LRFD Specifications for Highway Bridges.

Illustrate the configuration and magnitude of the construction loads. If the loads will vary during the phases of construction, then the details shall show the critical loads at each phase.

Verify that the stresses on the plans or contained in the specifications are not exceeded. In addition, joints with well distributed bonded reinforcing crossing them (as is typical in precast segmental construction) shall have no tension across them during construction or under service load after the structure is completed. The tension in any part of the prestressed concrete during construction shall not exceed 6(f'ci)1/2 or 3(f'ci)1/2 for the top of the deck. The tension in any part of the prestressed concrete under service load after the structure is completed shall not exceed 6(f'c)1/2 or 3(f'c)1/2 for the top of the deck.

Verify that the foundation or pier column capacities are not exceeded.

If the Developer intends to add temporary post-tensioning he shall submit complete details and calculations in accordance with subsection 618.03 (d) "Shop Drawings and Calculations" of this specification, for approval by the Engineer. The calculations shall meet the following requirements:

The calculations shall show that any stresses indicated on the plans or contained in these specifications are not exceeded, at any phase of construction.

The calculations shall consider all effects due to dead load, prestressing, and construction loads.

The calculations shall be prepared by an Engineer who is thoroughly knowledgeable in the design of post-tensioned, concrete bridges.

The calculations shall be prepared in accordance with the AASHTO Standard Specifications for Highway Bridges.

Temporary post-tensioning details shall meet the following requirements:

The temporary prestressing steel shall be clearly identified on the shop drawings.

The method, procedure, and sequence of tensioning and de-tensoning the temporary prestressing steel shall be shown. The sequence shall be related to the permanent post-tensioning.

Details shall show any ducts, blockouts, or buildouts necessary for the temporary prestressing steel. Ducts or voids internal to the member for temporary prestressing steel shall not be left void but shall be grouted in accordance with these specifications.

Stressing blocks for any temporary prestressing systems anchorages may be located within the slabs, in partial diaphragms within box girders, in external systems temporarily anchored to the girders and removed after used, or a combination of any of the above methods. All construction

REVISION OF SECTION 618
SEGMENTAL PRESTRESSED CONCRETE STRUCTURES

added outside a girder for temporary prestressing shall be subsequently removed to restore the girder to the designed cross-section shown on the plans or as approved by the Engineer.

The detail requirements for the temporary post-tensioning shall be in accordance with 618.03 (d) "Shop Drawings and Calculations".

The Engineer will have 5 weeks to review and approve the Developer's construction loading and temporary post-tensioning details and calculations. If the details are not approved, they will be returned for corrections and resubmitted by Developer, in the same manner as the first submittal.

The time required for approval of resubmittals will not be more than 5 weeks per submittal. It is the intent of these specifications that not more than two resubmittals will be required. If additional submittals are required by actions of the Developer, the additional time required for review and approval will be borne by the Developer.

Only after the Developer's construction loading and temporary post- tensioning details and calculations are approved will the Division review final shop drawings for post-tensioning, bearing devices, falsework, or expansion devices for the superstructure. Approval of these details and calculations will not relieve the Developer of the responsibility for the structural adequacy of the bridge, or the performance of the temporary post-tensioning, under construction loading.

REVISION OF SECTION 628
BRIDGE GIRDER AND DECK UNIT

Section 628 is hereby added to the Standard Specifications for this project as follows:

DESCRIPTION

This work consists of the design, fabrication, and erection of a simple span, welded self weathering steel, truss pedestrian bridge (with a timber or concrete deck) in accordance with the specifications and plan details.

Potential bridge suppliers are:

Continental Bridge
8301 State Highway 29 N
Alexandria, Minnesota 56308
1-800-328-2047, FAX 320-852-7067

Steadfast Bridges 4021 Gault Ave. South
Fort Payne, Alabama 35967
1-800-749-7515, FAX 256-845-9750

Excel Bridge Manufacturing Company
12001 Shoemaker Avenue
Santa Fe Springs, California 90670
562-944-0701, FAX 562-944-4025

Big R Manufacturing LLC
P.O. Box 1290
Greeley, Colorado 80632-1290
1-800-234-0734, FAX 1-970-356-9621

Wheeler Lumber, LLC 9330 James Avenue South
Bloomington, Minnesota 55431-2317
1-800-328-3986, FAX 952-929-2909

MATERIALS

Structural Steel. All structural steel shall be new (unused) material. The Developer shall provide the Engineer and the Staff Bridge Branch Fabrication Inspection Unit with copies of all certified mill test reports for all structural steel and bolts. Floor beams, stringers, and members of each Half-through truss (upper and lower chords, diagonals, end posts and vertical posts) utilized in the bridges shall meet a longitudinal Charpy V-notch (CVN) value of 25 ft. lbs. at 40 degrees Fahrenheit. Testing shall be in accordance with AASHTO T 243 (ASTM A 673). The H frequency of heat testing shall be used. The Developer shall provide the Engineer and the Staff Bridge Branch Fabrication Inspection Unit with certified copies of all CVN test reports.

All square and rectangular structural steel tubing shall conform to the requirements of ASTM A 847, Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing With Improved Atmospheric Corrosion Resistance.

REVISION OF SECTION 628
BRIDGE GIRDER AND DECK UNIT

All structural steel shapes and plates shall conform to the requirements of ASTM A 588, High- Strength Low-Alloy Structural Steel.

All anchor bolts and nuts shall conform to the requirements of ASTM A 307, Grade A, Carbon Steel Bolts and Studs, and shall be galvanized in accordance with the requirements of ASTM A

153. Each anchor bolt shall be provided with two nuts for jamming.

All structural steel field connections shall be bolted with high strength bolts. High strength bolts, including suitable nuts and plain hardened washers, shall conform to the requirements of ASTM A 325. Bolts shall be Type 3.

Timber. All timber shall be new (unused) material and conform to either of the following:

> Southern Pine, No. 1 or better quality, Graded in accordance with Southern Pine Inspection Bureau (SPIB)rules.
>
> Douglas Fir-Larch, No. 1 or better quality, Graded in accordance with West Coast Lumber Inspection Bureau (WCLIB) rules.

All lumber shall be manufactured and inspected in accordance with the latest edition of Product Standard 20-70 as published by the Department of Commerce, and shall be grade marked or have an accompanying certificate from a certified grading agency. The grading agency shall be certified by the Board of Review of the American Lumber Standards Committee.

All timber shall be pressure treated, conforming to the requirements of the American Wood Preserver's Association (AWPA) Standards, Section C1 and C2 (Soil Contact). Either Ammoniacal Copper Arsenate (ACA) or Chromated Copper Arsenate (CCA) preservatives conforming to the requirements of Section P5 (Standards For Waterborne Preservatives) of the AWPA Standards shall be utilized and treatment shall be to a total absorption of 0.40 pounds per cubic foot of timber. A certified treatment report shall be provided to the Engineer and the Staff Bridge Branch Fabrication Inspection Unit.

CONSTRUCTION REQUIREMENTS

Design. The AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges shall govern the design. Bolted connections shall comply with Section 509 of Standard Specifications for bolting requirements.

The superstructure of the pedestrian bridge shall consist of two parallel Half-through trusses, or Pony trusses, with at least one diagonal per panel. The trusses shall be the main load-carrying members of the bridge.

The members of each Half-through truss, or Pony truss, (upper and lower chords, diagonals, end posts, and vertical posts) shall be fabricated from square and rectangular structural steel tubing.

REVISION OF SECTION 628
BRIDGE GIRDER AND DECK UNIT

Floor beams and stringers shall be fabricated from structural steel shapes or square and rectangular structural steel tubing.

The structure shall conform to the clear span, clear width, and railing requirements shown on the plans.

Each pedestrian bridge shall be designed for the following loads and loading conditions:

Dead load shall be as defined in the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges.

Live load shall be as defined in the AASHTO LRFD Guide Specifications. Distribution to the stringer and floor beams shall be in accordance with the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges. Deflection and vibration limits as per the AASHTO LRFD Guide Specifications shall apply.

Pedestrian live load shall be as defined by the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges.

Vehicle live load shall be as defined by the LRFD Guide Specifications for the Design of Pedestrian Bridges. When required by the plans, the vehicle live load shall be the Colorado Legal Load Type 3 Vehicle. This is a 27 ton, three axle, vehicle with 13.5’ front axle spacing and 4’ rear spacing. The axle loads are 7 tons on the front axle and 10 tons on each of the rear axles.

Wind load shall be as defined by the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges.

Distribution of wheel loads on timber flooring shall be in accordance with the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges.

Minimum thickness of structural steel shall be 3/16 of an inch.

½ inch diameter weep holes shall be drilled (flame cut holes will not be allowed) at all low points of all steel tubing members as oriented in the in-place, completed structure. In members that are level, or flat, a total of two weep holes shall be drilled, one at each end. Weep holes and their locations shall be shown on the Shop Drawings.

All metallic fasteners utilized in attaching timber to structural steel shall be galvanized.

All welded tubular connections shall be designed in accordance with Section 2, Parts A and D (Delete Subsection 2.36.6), of the Structural Welding Code-Steel ANSI/AWS/D1.1 (Latest Edition).

REVISION OF SECTION 628
BRIDGE GIRDER AND DECK UNIT

When timber decking is used it shall be placed transverse to the trusses and have a minimum nominal thickness of 3 inches. Decking shall be securely fastened to each stringer and at each end to prevent warping.

Concrete and reinforcing steel, when used for the deck, shall conform to Sections 601 and 602, respectively.

The Developer shall submit seven sets of Design Calculations and Shop Fabrication Details (Shop Drawings) to the Engineer for each pedestrian bridge separately. This submittal shall be in accordance with Subsection 105.02. The Design Calculations and Shop Drawings shall contain the endorsement seal of the Professional Engineer registered in the State of Colorado responsible for the design.

Shop Fabrication. Welding and fabrication of weathering steel pedestrian bridges shall conform to the requirements of the Structural Welding Code-Steel ANSI/AWS D1.1 (Latest Edition) as amended by the following:

As required in Subsection 4.7.3, a welding procedure shall be established by qualification in accordance with the requirements of Subsection 3.3 for the ASTM A 847 material used on the bridge. The results of the Procedure Qualification shall be recorded on Form E-1 in Annex E of AWS D 1.1.

The Developer shall submit a Quality Control Plan. The Plan shall include personnel qualifications, certifications, and a Written Practice in accordance with ASNT SNT-TC-1A.

The quality of all welds shall be in accordance with Section 6, Table 6.1. In Table 6.1, Undercut 7(B), the criteria for primary members shall apply to the bottom chord members.

All Complete Joint Penetration Groove Welds in butt joints in the bottom chord members shall be 100% Magnetic Particle tested in accordance with ASTM E 709. Acceptance shall be determined in accordance with Section 6.10 and Table 6.1, using Alternating Current. In addition, complete joint penetration groove butt welds welded from one side without backing of bottom chord members shall be examined by ultrasonic testing in accordance with Section 6.11.1.

Magnetic Particle Testing shall be performed on 100% of all attachment welds to the bottom chord, using Alternating Current, in accordance with Section 6.10 and Table 6.1.

All Procedure Qualification Records and Welder Qualification Test Records shall be current within three years of the date of beginning fabrication.

A copy of all Procedure Qualification Records, Welder Qualification Test Records, Quality Control Plan and all visual and nondestructive test reports shall be provided to:

The Engineer.
Staff Bridge Branch Fabrication Inspection Unit
4201 E. Arkansas Ave., Room 330
Denver, Colorado 80222

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All weathering steel shall be blast cleaned, Steel Structures Painting Council Surface Preparation No. 6 (SSPC-SP6, Commercial Blast Cleaning), to remove mill scale and foreign material which would prohibit rusting to a uniform color.

Field Construction. The substructure shall be constructed in accordance with the details shown in the plans and the pedestrian bridge shop drawings. Before construction begins on the substructure, the Developer shall determine the anchor bolt requirements and substructure dimensions needed to properly erect the structure which will be provided. The Engineer shall be provided with two copies of detail sheets delineating these requirements before work begins.

14. LANDSCAPING AND AESTHETICS

14.1 General

The Developer shall design and construct all landscape and aesthetic Elements of the Project. This Section defines the requirements with which the Developer shall incorporate aesthetic treatments for the roadway, structures, drainage, and landscaping Elements of the Project.

14.2 Applicable Standards and Drawings

All Construction Work required to be performed by the Developer pursuant to this Section shall comply with Schedule 10A Applicable Standards and Specifications, the relevant requirements listed in this Section, and Good Industry Practice, including the following documents:

a. Local Agency Municipal Codes and Ordinances as applicable to the Project;

a. Swansea Elementary School requirements from the Denver Public Schools Intergovernmental Agreement (IGA);

b. The Conceptual Master Plan Exhibit from Schedule 10B Contract Drawings;

c. Approved Street Tree List for Denver's Public Rights-of-Way; and

d. Colorado Department of Transportation (CDOT) and the City and County of Denver (CCD) IGA.

14.3 Administrative Requirements

14.3.1 The Landscape and Aesthetics designs shall meet the requirements of the Draft I-70 East Preferred Alternative Aesthetic and Design Guidelines included in the Reference Documents.

14.3.2 The Landscape and Aesthetics designs shall conform to the design intent specified in the I-70 East Cover and Swansea Elementary School Master Plan included in the Reference Documents.

14.3.3 Landscaping and irrigation in Local Agency Roadway areas shall be designed and constructed to the Local Agency standards.

14.3.4 With the exception of the I-70 Mainline, Local Agency standards shall also be applied to all CDOT Roadways between the back of curb and the Right-of-Way (ROW) line.

14.3.5 The Landscape design and plans shall be prepared by a Registered Landscape Architect in the State of Colorado.

14.4 Design Requirements

14.4.1 Deterrence of Vandalism and Unauthorized Use of Facilities

The landscape and hardscape design shall discourage vandalism and discourage dwelling and the storage of personal items within the Site. All plantings shall use open-branch trees and shrubs that will minimize the collection of trash and debris. All plantings shall be designed and spaced to provide a safe space that deters unlawful behavior.

14.4.2 Irrigation

The Developer shall be responsible for the provision of water for irrigation and power supplies and other services required for establishment of the landscaping.

14.4.3 Landscape Design

The landscape design shall fall into three general categories as described below. The Developer's Landscape Plans shall include a schematic drawing of the Project showing where each category of landscaping is proposed.

a. Non-irrigated Areas

These areas includes plants which, once established, shall not require supplemental water from irrigation. Within Local Agency areas, conform with Local Agency standards.

b. Irrigated Areas

These areas will require plantings and irrigation systems. They will typically be within Local Agency ROW, CDOT ROW which falls under an IGA with a Local Agency, or private property where Construction Work is occurring under an easement. Known irrigated areas are provided in Schedule 10 B Contract Drawings.

c. Cover and Swansea Elementary School Area

This will require landscape, irrigation, aesthetics, additional playground facilities, parking lot, and miscellaneous park features in these areas conforming to the specific design requirements as described in this Section.

14.5 Cover and Swansea Elementary School Landscape and Aesthetic Design Plans

14.5.1 The Developer shall be responsible for the design and construction of all aspects of the Cover over the I-70 Mainline (Planning Area 2) and the Swansea Elementary School outdoor area (Planning Area 1) as depicted in the Conceptual Master Plan Exhibit provided in Schedule 10B Contract Drawings.

14.5.2 The Developer shall prepare the landscape and aesthetics plans for the Swansea Elementary School outdoor area in conformance with Denver Public Schools Design and Construction Standards and Good Industry Practice. The Developer shall coordinate the design with Denver Public Schools and obtain approval prior to submittal to the Department.

14.5.3 The Developer shall have prepared a preliminary landscape and aesthetics plans for the Cover and Swansea Elementary School outdoor area as part of its Proposal. The Developer shall prepare and submit revised preliminary landscape and aesthetics plans for Approval by the Department. The preliminary landscape and aesthetics plan submittal shall include as a minimum the following narratives and plans:

a. Narrative of the Developers design process to be completed and approach to achieving the vision set forth for the space both in program and character.

b. Narrative and plans that outline the opportunities and constraints in the design and construction Elements.

c. Narrative and plans for the cross streets, Columbine, Clayton, and 46th Avenue, depicting the character and context of how they relate to the Cover and Swansea Elementary School landscaping and aesthetic designs.

d. Narrative and plans related to the coordination and integration of other disciplines including structures, MEP Systems, drainage, roadway, utilities, and lighting.

e. The Developer shall provide visual renderings that show the proposed designs. A minimum of one rendering for each identified Master Plan Program Elements is required (12 each).

f. The Developer's preliminary landscape and aesthetics plans shall include plans, elevations, sections, perspectives, isometric drawings, details, etc., as necessary to fully convey the proposed Cover and Swansea Elementary School landscape and urban designs including color and texture applications; drawings, tables and schedule that show where specific Elements are located; and plant palette schedules, size, number, location of trees, shrub beds, accent beds, planning types.

g. The Developer's Landscape and Aesthetics work shall include an underground permanent irrigation system to maintain plant material.

14.5.4 The Developer shall prepare and submit the Final (100% level) landscape and aesthetics plans for the Cover and Swansea Elementary School outdoor area to the Department for Acceptance. The Landscape Plan shall address all comments and include all accepted Elements of the Preliminary Plans.

14.6 Corridor Landscape Design and Plans

14.6.1 Existing Site Inventory

a. The Developer shall prepare plan sheets and supporting data which document the existing landscape and irrigation system facilities including present conditions. These documents shall be designated as the Existing Site Inventory. The Existing Site Inventory shall be Accepted as a condition to NTP 2. The Existing Site Inventory shall be prepared in accordance with the CDOT *Landscape Architecture Manual*, Appendix 5 – Landscape Plan Development. In addition, the Existing Site Inventory shall include:

i. Locations of wetlands, SB40 Areas, and riparian areas; the locations formally landscaped areas; the locations of irrigated areas, and the locations of other non-paved areas. The wetland/SB40/riparian details shall include a tree and shrub inventory. All areas shall have a description of the existing vegetation and conditions;

ii. Vegetation location and identification (including photo documentation), including species, location, condition, size, health, and a recommendation for remaining undisturbed, pruning, removal, transplanting, or replacement;

iii. Details of landscapes and irrigation systems impacted by the Project; and

iv. Locations of protected areas.

14.6.2 Preliminary (30% Level) Landscape Plans

a. The Developer shall prepare and submit the Preliminary (30% level) Landscape Plan to the Department for Acceptance. The Landscape Plan shall be prepared in accordance with the CDOT *Landscape Architecture Manual*, Appendix 5 – Landscape Plan Development. In addition, include the following:

i. The landscape Design;

ii. Locations, mitigations, removals, and replacements of trees, shrubs, landscapes and irrigation impacted by the Project;

iii. Proposed locations of replacement or proposed transplanted vegetation within the Site;

iv. Proposed tree species for I-70 Mainline based on the species and conditions as outlined by the State of Colorado portion of the FHWA *The Roadside Use of Native Plants*;

v. Proposed tree species for Local Agency landscaping areas. The Developer shall use Local Agency requirements;

vi. Proposed seed mixes;

vii. Description of how landscape designs will coordinated into aesthetics for other portions of the Construction Work; including the walls, drainage, structures, streetscape, lighting and fences; and

viii. Inclusion of aesthetic Elements unless these are provided under separate discipline specific plan submittals. Where aesthetic designs are provided elsewhere, provide specific reference to these locations.

b. Final (100% Level) Landscape Plans

The Developer shall prepare and submit the Final (100% level) Landscape Plan to the Department for Acceptance. The Landscape Plan shall address all comments and include all Accepted Elements of the Preliminary Plan.

14.7 Aesthetic Requirements

14.7.1 Bridges

a. The Developer shall design the finishes and colors for all proposed bridge super- and substructures, bridge columns, pier caps, girders, abutments, barrier rails, wing walls, retaining walls, noise walls, slope paving in accordance with the concepts of the Aesthetic Guidelines Report provided in the Reference Documents as well as the requirements provided in the Bridge Aesthetic Design Details in Schedule 10B Contract Drawings. Existing structures do not need to be modified to comply with these requirements.

b. The Developer's design shall create visually appealing transitions between various project Elements. (For example, the transition between a noise wall adjacent to a bridge and the noise wall on the bridge shall blend together.)

c. Bridge Elements that shall be included in the aesthetic treatments include the bridge super- and substructures, columns, bridge rail, barriers, pedestrian fencing, retaining walls, lighting, and slope paving.

d. Girders on an individual bridge shall have a consistent depth along the bridge to the greatest extent possible.

e. All exposed drain pipes shall be painted to match adjacent bridge Elements. They shall be positioned where least viewed from the roadway.

14.7.2 Retaining Walls and Noise Walls

a. The Developer shall design and construct walls at the locations and with aesthetic treatments as provided in the Wall Aesthetic Design Details in Schedule 10B Contract Drawings.

14.7.3 Medians

a. Where medians are six feet wide or narrower and within islands; hardscape treatments of colored, stamped, or artistic paving shall be provided. Medians greater than six feet wide shall be designed and constructed with landscaping and irrigation.

14.7.4 Grading and Slope Paving Aesthetics

a. The Developer shall perform all finished grading to maintain an aesthetically pleasing surface, consistent with CDOT best practices;

b. Existing slopes that are changed, removed, replaced, refreshed, or altered within the Project Limits shall be treated as new slopes and reconfigured to be consistent with the requirements described in the I-70 East Preferred Alternative Aesthetic and Design Guidelines; and

c. Where used, slope paving shall comply with the requirements described in the I-70 East Preferred Alternative Aesthetic and Design Guidelines.

14.7.5 Fencing

Fencing shall comply with the requirements described in the I-70 East Preferred Alternative Aesthetic and Design Guidelines.

14.7.6 Temporary Wall at Swansea Elementary School

The Developer shall design and construct a temporary wall between I-70/Columbine Street and Swansea Elementary School for use during the Construction Period. The wall shall be in place prior to initiation of any Construction Activities within 200 feet of the school ROW. The location and limit of the temporary wall as well as the aesthetic requirements are shown in Schedule 10B Contract Drawings. The wall shall provide visual screening and reduce noise and dust at the school. The wall shall be constructed of a material that has a minimum density of 4 pounds per square foot. The wall shall be 12 feet tall and constructed without open joints or gaps.

14.8 Landscape Requirements

14.8.1 The Developer's Environmental Compliance Work Plan (ECWP) shall include an organization chart showing Developer's organization of the personnel responsible of implementing the Developer's landscape, irrigation, and noxious weed control programs. The plan shall specifically identify the individuals and positions who shall serve in the key roles, including the Engineer, referenced in the following sections of the CDOT *Standard Specifications*:

a. Section 212, Seeding, Fertilizer, Soil Conditioner, and Sodding

b. Section 213, Mulching

c. Section 214, Planting

d. Section 215, Transplanting

e. Section 216, Soil Retention Covering

f. Section 217, Herbicide Treatment

g. Section 613, Irrigation Systems

14.8.2 The sections listed above shall be referred to for the Landscape Construction Work requirements for this Section.

14.8.3 The Plan shall include a detailed description of the roles that the Developer's Process Control (PC) and Developer's Independent Quality Control (IQC) programs shall be assigned to implement the hold points and decision points required in the sections above.

14.8.4 The Developer shall notify the Department and invite the Department to attend all of inspections required by the Landscape Construction Requirements a minimum of three Calendar Days in advance.

14.8.5 The landscape plan As-Builts shall be completed by Registered Landscape Architect in the State of Colorado.

14.8.6 Protection and Preservation

The Developer shall save, protect, and maintain all existing vegetation during implementation of the Construction Work, except for that vegetation that requires removal as part of the final Project. All construction operations shall be performed in such a manner that will avoid these Protected Areas.

14.8.7 Landscaping Completion and Establishment

a. Landscape completion

i. Completion of all landscaping is a Final Acceptance Condition. All plants shall have been planted and all irrigation items shall be operational in compliance with the requirements of this Section. Plants shall be healthy and in flourishing condition and be free of dying branches and branch tips, and shall bear foliage of normal density, size, and color. All mulch beds shall be completely mulched;

ii. The Developer shall submit a Landscape Maintenance Plan in accordance with the requirements of Section 214 of the CDOT *Standard Specifications*; and

iii. When the Developer considers that all the conditions relating to landscape completion have been achieved, it will notify the Department to arrange a joint landscape inspection with the Developer's Landscape Architect.

b. Landscape Establishment

i. The Developer shall meet the requirement of Section 214.04 of the CDOT Standard Specifications during the Landscape Establishment period (as described in that Section); and

ii. All landscape installations shall be completely maintained by the Developer during the Landscape Establishment period in accordance with the requirements of Schedule 11 Operations and Maintenance Requirements.

iii. The Developer shall audit the landscape installations on at least a monthly basis and Nonconforming Work will be repaired in accordance with the requirements of Schedule 11 Operations and Maintenance Requirements.

iv. At the end of the Landscape Establishment period, the Developer will inspect the landscaping to determine compliance to the requirements of the Project Agreement. All landscape installations shall be fully established, weed-free, clean, smooth, properly graded, and without plant mortality to be Accepted. Should the Developer identify any areas of Nonconforming Work, the Developer shall correct the deficiencies and extend the Landscape Establishment period for a minimum of one additional growing season.

14.9 Deliverables

The Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the timeframes specified:

Table 14-1 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Existing Site Inventory	Acceptance	Condition to the issuance of NTP 2
Landscape Plans	Acceptance	Prior to RFC Documents
Landscape Maintenance Plan	Information	Condition of Landscape Completion
Certificate of Compliance for Imported Topsoil	Information	Prior to hauling topsoil to the Project

14.10 Appendices

Appendix A Project Special Provisions

Appendix A
Project Special Provisions

The following specifications modify and take precedence over the Standard Specifications. The requirements of Appendix A to Schedule 10A Applicable Standards and Specifications apply to these Project Special Provisions.

PROJECT SPECIAL PROVISIONS

SECTION 519
GARDEN ROOF ASSEMBLY

Section 519 is hereby added to the Standard Specifications for the project as follows:

DESCRIPTION

519.01 This work consists of furnishing and installing Waterproofing and Garden Roof Assemblies including, Monolithic Membrane and flashings, protection course / root barrier protection, geofoam, drainage / water retention components, growing media confinement system and lightweight engineered growing medium (soil). To ensure compatibility, all components of the Garden Roof Assembly shall be provided by a single manufacturer.

MATERIALS

519.02 All material requirements are as follows:

(a) *Membrane.* Membrane shall be a hot, fluid applied, rubberized asphalt membrane meeting the standards in Schedule 10A, Applicable Standards, Data, and Reports and other pertinent physical properties:

PROPERTY	TEST METHOD	TYPICAL RESULT
Flash point	ASTM D-92	<500°F*
Penetration	ASTM D-5329	3.9 in @77°F (25°C)
Flow	ASTM D-5329	0.04 in @ 140°F (60°C)
Toughness	CGSB-37.50-M89	16.0 Joules
Ratio of Toughness to Peak Load	CGSB-37.50-M89	0.069
Water Vapor Permeability	ASTM E-96, PROCEDURE E CGSB-37.50-M89	0.3 ng/Pa(s)M^2
Water Absorption	CGSB-37.50-M89	.11 gram weight gain
Low Temperature Flexibility (-25°C)	CGSB-37.50-M89	No delamination, adhesion loss, or cracking or cracking
Low Temperature Crack Bridging Capability	CGSB-37.50-M89	No cracking, adhesion loss, or splitting
Heat Stability	CGSB-37.50-M89	No change in viscosity, penetration, flow or low temperature flexibility
Viscosity	CGSB-37.50-M89	11.0 seconds
Water Resistance (5 days/50°C)	CGSB-37.50-M89	No delamination, blistering, emulsification, or deterioration
Softening Point	ASTM D-36	180°F (82°C)
Elongation	ASTM D-5329	1000% minimum
Resiliency	ASTM D-3407	40% minimum
Bond to Concrete	ASTM D-3407	Pass 0°F (-18°C)
Acid Resistance	ASTM D-896 Procedure 7.1 (N-8)	Pass-50% Nitric Acid -50% Sulfuric Acid

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PROPERTY	TEST METHOD	TYPICAL RESULT
Resistance to Hydrostatic Pressure	ASTM D-08.22 Draft 2	100 psi (equals 231 foot of head water)
Resistance to Salt Water	ASTM D-896 similar 20% sodium chloride sodium carbonate calcium chloride	No delamination, blistering, emulsification or deterioration
Resistance to Fertilizer	ASTM D-896 similar undiluted, 15/5/5, nitrogen/phosphorus/potash	No delamination, blistering, emulsification or deterioration
Resistance to Animal Waste	3-year exposure	No deterioration
Solids Content		100%-no solvents
Shelf Life		10 years (sealed)
Specific Gravity		1.23 + .02
*102°F more than the application temperature recommended by the manufacturer.		

(b) *Reinforcing*

1. Standard Duty Reinforcing: Spunbonded polyester fabric membrane reinforcing sheet in standard widths of 6, 12, and 39 inches and a length of 600 feet, meeting the following requirements:

PROPERTY	TEST METHOD	TYPICAL RESULT
Color	NA	White
Unit Weight (oz/sq yd)	ASTM D1910	1.35
% Elongation (to break)	ASTM D2523	42
Tear Strength (lb)	ASTM D2263	8
Breaking Strength (lb)	ASTM 2523	25
De Matia Flex Cycles	ASTM D813	100,000

2. Heavy Duty Reinforcing: 60-mil (1.5 mm) thick, in standard widths of 6, 12, 18, 24, 36 and 48 inches, and a length of 100 feet, uncured neoprene membrane reinforcing sheet meeting the following requirements:

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PROPERTY	TEST METHOD	TYPICAL RESULT
Width (inch)	ASTM D751-66	0 /+ 0.125
Length (inches)	ASTM D751-66	0 /+ 1.0
Thickness (inches)	ASTM D751-66	0.060 +/- 10%
Tensile Strength (psi, min)	ASTM D412, Die C	1400
Elongation (%, min)	ASTM D412, Die C	300
Tear resistance (lb/inch, min)	ASTM D624, Die C	125
Brittleness Point @ -30° F	ASTM D2137	No Break
Ozone Resistance (@20% Ext., 100 MPa, 100 hrs @ 104° F	ASTM 1149	No Cracks @ 7x Magnif.
Water Absorption (%, weight change range) (46 hrs. @ 158° F)	ASTM D471	-8, +2

(c) *Flashing*

1. 60-mil (1.5 mm) thick, uncured neoprene sheet meeting the requirements of Heavy Duty Reinforcing

2. Two-component, liquid applied resin membrane flashing system.

   A. Poly methyl-methacrylate (PMMA) resin per manufacturer's recommendations.

   B. Acrylic resin with integral chopped polymer fiber reinforcement per manufacturer's recommendations.

   C. Resin based primers, additives, reinforcing fleece, surfacing topcoats per manufacturer's recommendations.

(d) *Protection Course / Root Barrier Protection – at Landscape Areas:* 160-mil (4 mm) thick polyester reinforced, rubberized asphalt sheet with granular surface and root inhibiting additive. Roll size shall be approximately 39 inches wide by 33 feet long, and have a minimum tensile strength of 50 lbs/inch (machine & cross direction @ 163°F (73°C).

(e) *Protection Course – at Vehicular Traffic Areas:* 85-mil (2 mm) thick heavy duty, rubberized asphalt protection sheet with synthetic fiber reinforcement. Roll size shall be approximately 39 inches wide by 50 feet long.

(f) *Insulation:* Expanded Polystyrene (EPS) Geofoam

1. Foam-Control EPS Geofoam Type EPS29 in compliance with the following properties:

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FOAM-CONTROL EPS GEOFOAM PROPERTIES								
PROPERTY	**UNITS**	**ASTM D6817**						
		EPS12	**EPS15**	**EPS19**	**EPS22**	**EPS29**	**EPS39**	**EPS46**
Density[1], min.	lb/ft^3	0.70	0.90	1.15	1.35	1.80	2.40	2.85
Compressive Resistance[1,2] @ 1% deformation, min.	psi	2.2	3.6	5.8	7.3	10.9	15.0	18.6
Elastic Modulus[1], min	psi	220	360	580	730	1090	1500	1860
Flexural Strength[1], min.	psi	10.0	25.0	30.0	35.0	50.0	60.0	75.0
Water Absorption[1] by total immersion, max.	vol. %	4.0	4.0	3.0	3.0	2.0	2.0	2.0
Oxygen Index[1], min.	vol. %	24	24	24	24	24	24	24
Buoyancy Force	lb/ft^3	61.7	61.5	61.3	61.1	60.6	60.0	59.5
Additional Properties for Compressible Applications								
Compressive Resistance[1] @ 5% deformation, min.	psi	5.1	8.0	13.1	16.7	24.7	35.0	43.5
Compressive Resistance1 @ 10% deformation, min.	psi	5.8	10.2	16.0	19.6	29.0	40.0	50.0
See ASTM D6817 Standard for test methods and complete information Combined live and dead load stresses should not exceed the compressive resistance at 1% deformation.								

2. All Foam-Control EPS Geofoam blocks shall be treated by the manufacturer with a tested and proven termite treatment for below grade applications, 3 year minimum field exposure. The treatment shall be EPA registered, meet requirements of ICC ES EG239, and be recognized in an ICC ES report.

3. Geogripper Plates – The plates shall be made of 20 gauge galvanized or stainless steel, 4”x4” with two-sided 0.6” high multi-barbed design capable of piercing the EPS Geofoam. Each plate shall be capable of a lateral holding strength of 60 lbs.

(g) *Drainage/Water Retention Component*

1. Hydrodrain Air Layer: Composite drainage system consisting of a three dimensional, crush-proof, drainage core and filter fabric meeting the following requirements for Geonet Style 300:

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PROPERTY	TEST METHOD	UNITS	Geonet Style			Dimple Style			
			300	302	1000	400	420	700	900
Thickness	ASTM D1777	Inch	0.25	0.25	0.25	0.40	0.40	0.40	0.40
Compressive Strength	ASTM D1621	psf	40,000	40,000	40,000	15,000	15,000	21,000	30,000
Core Flow @ 3600 psf; hydraulic gradient = 1 (per unit width)	ASTM D4716	Gal/min/ft	8.5	8.5	8.5	21	21	23	24
Fabric Flow	ASTM D4491	Gal/min/ft^2	140	140	140	140	140	18	18
Fabric Grab Tensile Strength	ASTM D4632	Lb	100	100	100	100	100	MD 370 (1.65)	MD 370 (1.65)
Fabric AOS	ASTM 4751	U.S. Sieve	70	70	70	70	70	70	70
Fabric Puncture Strength	ASTM D4833	Lb	65	65	65	65	65	120	120
Fabric UV Resistance @ 500 hours	ASTM D4355	%Strength Retained	70	70	70	70	70	90	90
Roll Dimensions	NA	Ft	4x75	4x75	4x50	4x50	4x50	4x50	4x50
Roll Weight	NA	Lb	70	80	55	39	42	47	52

2. Gardendrain Moisture Panels: Three-dimensional, molded panels of recycled polyethylene with drainage channels top and bottom sides and water retention reservoirs top side meeting the following requirements:

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PROPERTY	TEST METHOD	TYPICAL RESULT
Panel Dimensions	NA	4 ft. x 6 ft.
Panel Height	NA	2 inches
Weight w/cups empty w/cups filled	NA	 0.4 lb/ft^2 dry; 2.0 lb/ft^2 wet 4.3 lb/ft^2 dry; 6.3 lb/ft^2 wet
Strength w/cups empty w/cups filled	ASTM D1621	 3,154 lb/ft^2 > 7,000 lb/ft^2
Flow Rate	ASTM D4716	42 gal./min./ft width; h.g. = 1
Water Retention w/cups empty w/cups filled	NA	 0.19 gal/ft^2 0.20 gal/ft^2
Volume to Fill	NA	0.08 ft^3/sf in area

3. Moisture Retention Mat: A moisture retention fabric composed of high-quality, non-rotting polypropylene fibers. The fabric shall be approximately 3/16inch thick, in rolls of approximately 7.5 feet wide by 100 feet long, with a water retention capacity of approximately 0.13 gal./ft^2 (5.3 l/m^2), meeting the following requirements:

PROPERTY	TEST METHOD	TYPICAL RESULT
Tensile Strength	ASTM D4632	380 lb
Elongation:	ASTM D4632	50%
Trapezoidal Tear:	ASTM D4533	145 lb/in^2
Puncture Strength	ASTM D4833	240 lb

(h) *Drainage/Soil Confinement Components:* Confinement components shall be provided where the concrete substrate surface is sloped greater than 10°.

1. Expandable polyethylene sheet strip assembly, connected by a series of offset, full depth ultrasonic welded seams aligned perpendicular to longitudinal axis of strips which, when expanded, form walls of a flexible, 3-dimensional, confinement system. , meeting the following requirements:

   A. Strip sheet height: 12 inches.

   B. Strip sheet thickness: 50 mil (-5%, +10%) per ASTM D5199

   C. The polyethylene shall have a density of 58.4-60.2 lb/cu.ft. (0.935-0.965 g/cm^3) per ASTM D1505.

   D. The polyethylene shall have an Environmental Stress Crack Resistance (ESCR) of 3000 hours tested per ASTM D1693.

   E. Carbon black content for UV stabilization shall be 1.5%-2% by weight, distributed throughout the material.

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F. Cell seam strength shall be uniform over the full depth of the cell. Minimum seam peel strengths shall be 80 lb (355 N) per inch of cell depth.

G. Long-term seam peel-strength test shall be performed on all resin or pre-manufactured sheet or strips. A 4" (100 mm) wide seam sample shall support a 160 lb (72.5 kg) load for a period of 168 hours (7 days) minimum in a temperature-controlled environment undergoing a temperature change on a 1-hour cycle from ambient room to 130 °F (54C).

2. Integral Stainless Steel Cable Tendons (if needed) per manufacturer's recommendations.

3. Cable stops, oval sleeves, steel washers and polyethylene washers per manufacturer's recommendations.

(i) *Filter Fabrics*

1. Non-woven, polymeric, geotextile fabric meeting the following requirements:

PROPERTY	TEST METHOD	TYPICAL RESULT
Roll Size	NA	12.5 ft x 120 ft
Weight	ASTM D5261	3.5 oz/yd^2
Flow Rate	ASTM D4491	150 gal/min/ft^2
Tensile Strength	ASTM D4632	90 lb
Elongation	ASTM D4632	50%
Mullen Burst	ASTM D3786	185 lb/in^2
Puncture Strength	ASTM D4833	60 lb
Trapezoidal Tear	ASTM D4533	40 lb
Apparent Opening	ASTM D4751	50

(j) *Soil*

1. Custom Growing Media Mix capable of supporting vigorous growth of the specified vegetation, complying with the following specification:

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PROPERTY	TEST METHOD	TYPICAL RESULT*
Grain Size Distribution	NA	
Clay fraction		0 – 2 %
Passing #200 Sieve		5 – 15%
Passing #60 Sieve		10 – 25%
Passing #18 Sieve		20 – 50%
Passing 1/8-inch sieve		55 – 95%
Passing 3/8-inch sieve		90 – 100%
Density	NA	
Application Density		44 – 68 lbs/ft^3
Saturated Density		62 – 93 lbs/ft^3
Dry Density		38 – 68 lbs/ft^3
Water & Air Management (% Vol.)	NA	
Saturated water capacity		> 40%
Saturated air content		> 10%
Saturated Hydraulic Conductivity	NA	> 1.0 in/hr
pH, Lime, and Salt Content	NA	
pH (saturated paste)		5.5 – 7.5
carbonate content		< 25 g/l
salts content (water extract)		< 3.0 g/l
Organics	NA	
OM content		6 – 12 mass %
C/N ratio		< 20
Nutrients **	NA	
Nitrogen (NO3)		3 – 15
Phosphorus		1 – 7
Potassium		6 – 15
Calcium		19 – 65
Magnesium		3 - 15
CEC Capacity	NA	> 6 cmol/kg
Compost Fraction 1. Meet or exceed USEPA Class A standard, 40 CFR 503.13, Tables 1 & 3 (chemical contaminants) and 40 CFR 503.32(a) (pathogens) and/or be permitted in the state of origin to produce Class A material. 2. Meet US Compost Council STA/TMECC criteria or equal for Class I or II stable, mature product.		
* Values may be adjusted due to availability of local materials or special project conditions related to plant selection and/or environmental conditions, pending approval of the engineer. ** Nutrients shall be adjusted with appropriate slow-release fertilizer with micronutrient additions if below lower target range.		

2. Expanded Lightweight Aggregate for use as fill material at vegetation-free zones shall meet the following specification:

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PROPERTY	TEST METHOD	TYPICAL RESULT
Grain Size Distribution	NA	
Clay fraction		< 1%
% passing #18 Sieve		1 – 3%
%passing 1/4-inch Sieve		10 - 30%
% passing 3/8-inch Sieve		90 – 100%
Density	NA	
Saturated Density		< 60 lb/ft^3
Dry Density		< 50 lb/ft^3
Saturated Hydraulic Conductivity	NA	> 15 inch/minute
pH, Lime, and Salt Content	NA	
pH (in $CaCl_2$)		6.0 – 8.5
carbonate content		< 25 g/l
salts content (water extract)		< 2.5 g/l
Organics		
OM content	NA	< 1% mass
Abrasion Resistance	ASTM C131-96	< 25% loss
Soundness	ASTM C88	< 0.50% loss

(k) *Garden Roof Accessory Components:*

1. Drain Inspection Chambers - 18 gauge stainless steel, over-drain inspection boxes, with perforated sides and removable lids. Utilize extensions to increase the height for deeper growing media applications.

2. Vegetation Transition Areas – Metal Angle of unfinished aluminum bent at a 90 degree angle, with a slotted vertical leg to allow for drainage.

(l) *Erosion Control Materials*

1. Erosion Control Mat. Biodegradable Erosion Control Matting: Composed of straw and/or coconut fiber stitched together with biodegradable thread forming top and bottom netting, meeting the following requirements:

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PROPERTY	TEST METHOD	TYPICAL RESULT
Width (feet)	NA	6.67 +/- 5%
Length (feet)	NA	108.0 +/- 5%
Thickness (inches)	ASTM D5199 / ECTC[1]	0.26
Weight (oz/yd^2)	ASTM D5261	8.83
Tensile Strength (MD[2] – lb/ft)	ASTM D5035	342
Tensile Strength (TD[3] – lb/ft)	ASTM 5035	211
Elongation (MD - %)	ASTM D5035	7.6
Elongation (TD - %)	ASTM D5035	11.1
Water Absorption (%)	ASTM D1117 / ECTC	0.11
Resiliency (%)	ECTC	85
Stiffness / Flexibility (oz-in)	ASTM D1388 / ECTC	0.11
Smolder Resistance	ECTC	YES[4]
1. ECTC = Erosion Control Technology Council 2. MD = Machine Direction 3. TD = Transverse Direction 4. Material is smolder resistant according to ECTC Guidelines		

2. Heavy-Duty Anchors. Plastic Anchor Disk with connected plastic stem and friction-fit plastic top disk used to fasten Biodegradable Erosion Control Matting or sedum carpet and tile. The plastic anchor shall have the following thicknesses: Base Disk: 3/16 inch; Shaft: 3/8 inch diameter; Top Disk: 0.03 inch. The plastic anchor length and width shall be as follows: Base Disk: 5 inch diameter; Shaft: 12 inch; Top Disk: 4.75" diameter.

3. Hydromulch. Wood fiber-based hydromulch with natural-based tackifier for use in securing sedum cuttings on the application area. Hydromulch shall be mixed with tackifier and applied as wet slurry to cutting installations.

4. Dry Hydromulch. Wood fiber or straw-based hydromulch with integrally mixed guar-based tackifier. For use where hydromulching equipment and access is not possible. Dry hydromulch shall be applied in accordance with these specifications and per manufacturer's recommendations.

CONSTRUCTION REQUIREMENTS

519.03 Submittals. The contractor shall submit testing results to ensure materials meet the following qualifications:

(a) Certification from an approved independent testing laboratory experienced in testing this type material, that the material meets these specifications for rubberized asphalt membranes (testing not greater than 5 years old) 25% post-consumer recycled rubber content and inert clay fillers. Testing shall be done by a national testing laboratory acceptable to the engineer.

(b) Certification and description of the full time quality control/quality assurance program of production facilities responsible for the manufacture of the rubberized asphalt and that each batch of material is tested to insure conformance with the manufacturer's published physical properties.

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The quality assurance program description shall include all methods of testing for physical and mechanical property values. Provide confirmation of manufacturer's certificate of analysis for reporting the tested values of the actual material being supplied for the project prior to issuance of the specified warrantee.

(c) Certification showing that all components of the Green Roof Assembly are being supplied and warranted by a single-source manufacturer.

(d) Documentation that the roof membrane assembly is currently Class A listed with Underwriters Laboratories.

(e) Documentation from an approved, independent testing laboratory that the extruded polystyrene insulation if used is free from CFC's.

(f) The plant manufacturing the rubberized asphalt material shall have IS0 9001-2000 approval as evidenced by a notarized copy of the official certificate.

(g) Provide product data on all components of the Garden Roof Assembly.

(h) Documentation that the waterproof membrane assembly is currently listed as a Class 1 Roof Cover with Factory Mutual Research Company Standard 4470 listing for the proposed membrane system. The waterproof membrane configuration shall be approved by FM for Class 1-SH (severe hail) exposure.

(i) Documentation from an approved, independent testing laboratory that the roofing membrane is resistant to salt water when tested in accordance with ASTM D-896.

(j) Documentation from an approved, independent testing laboratory that the roofing membrane is resistant to fertilizer when tested in accordance with ASTM D-896.

(k) Documentation that the roofing membrane is resistant to a three year exposure to animal waste.

(l) Documentation from an approved, independent testing laboratory that the roofing membrane can withstand a minimum 100 psi resistance to hydrostatic head in accordance with ASTM D-08.22.

(m) Documentation from an approved, independent testing laboratory that the Garden Roof Assembly root barrier has the ability to resist normal root or rhizome penetration as required by ANSI/SPRI VR_1 2011 “Procedure for Investigating Resistance to Root Penetration on Vegetative Roofs”. The documentation shall consist of the testing laboratories report summarizing the successful testing of all seams, edges, and methods of attachment that are exposed to roots or rhizomes for a period of at least 24 months.

(n) Stormwater performance of the Garden Roof Assembly utilized for this project shall be provided and include:

1. Composite Curve Number (CN)

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2. Composite C factor

3. Total volume of water stored in the growing media

4. Total volume of water stored in the water retention / drainage element

5. Hydrograph of vegetated roof system showing storm water release delay and stormwater volume reduction.

(o) List of 3 of the proposed primary membrane manufacturer's projects, located in the State of Colorado, of similar size and degree of difficulty which have been performing successfully for a period of at least 20 years. Provide current phone contacts of Architects and Owners for verification.

519.04 Quality Assurance.

(a) Waterproofing Contractor Qualifications: All Waterproofing work shall be performed by a company specializing in performing the work of this section with at least 10 continuous years documented experience and certified by the membrane manufacturer.

1. Certification: Certification or licensing shall have been in effect continuously for at least ten (10) years prior to bidding on this Project.

2. Contractor shall have at least ten years of experience in installing materials specified and shall have successfully completed at least three projects of similar scope and complexity in the state of Colorado. Provide current phone contacts of Architects and Owners for verification.

A. Contractor Certification: Obtain written certification from manufacturer of rubberized asphalt waterproofing system certifying that Contractor is approved by manufacturer for installation of specified membrane system. Provide copy of certification to Owner prior to commencement of waterproofing work.

B. Contractor's Field Supervision: Installer must maintain full-time supervisor/foreman on jobsite during times that waterproofing work is in progress.

C. Manufacturer's Field Supervision: The manufacturer shall maintain supervision of the work and have a full time representative witnessing the work in progress on a weekly basis (different time of day each week so that all parts of the work can be inspected), with a minimum of 8 hours per week.

3. Contractor shall designate a single individual as project foreman who shall be on site at all times during installation. Foreman shall be employed by the Contractor for at least five (5) years and have at least ten (10) years of experience installing the specified product. Contractor shall designate key personnel of the on-site crew who shall be experienced in work of the type specified. Neither the foreman nor the key personnel shall be changed without the Owner’s consent.

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4. The following is a list of pre-approved Waterproofing Contractors meeting these qualifications:

   A. AAA Waterproofing

   B. Black Roofing

   C. Douglass Colony

(b) The Garden Roof Assembly Installing Contractor: The contractor performing all work other than Waterproofing shall demonstrate qualifications to perform the work of the section by submitting the following documentation:

1. Certification or license by the Garden Roof Assembly supplier as a locally based, authorized applicator of the products intended for use, that the contractor has a minimum of five (5) years of experience on similar projects. The Garden Roof Assembly Installing Contractor shall have completed the green roof assembly suppliers training seminar.

2. List of at least three (3) projects, satisfactory completed within the past five (5) years, of similar scope and complexity to this project. Previous experience submittal shall correspond to specific membrane system specified on the plans and in these specifications.

3. The following is a list of pre-approved Garden Roof Assembly Installing Contractors meeting these qualifications:

   A. Environmental Landworks

   B. Land Tech

   C. MGT

   D. Schultz Industries

   E. Valley Crest

(c) The Garden Roof Assembly Maintenance Contractor shall demonstrate qualifications to perform the work of this Section by submitting the following documentation:

1. List of at least three (3) Garden Roof Assembly projects, satisfactorily completed within the past five (5) years, of similar scope and complexity to this project. Previous experience submittal shall correspond to specific membrane systems specified on the plans and in these specifications.

(d) Membrane Manufacturer Qualifications: Manufacturer shall demonstrate qualifications to supply materials of this section by certifying the following:

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1. Membrane Manufacturer shall provide documentation that the specified rubberized asphalt has been manufactured by the same source for at least ten (20) years and successfully installed on a yearly basis for a minimum of ten (20) years on projects of similar scope and complexity.

2. Membrane Manufacturer shall not issue warranties for terms longer than they have been manufacturing their hot fluid rubberized asphalt membrane.

(e) The rubberized asphalt membrane product shall contain an inert clay filler and crumb rubber to enable the product to be resistant to acids (fertilizers, building washes and acid rain) and maintain membrane thickness during application. Membrane Manufacturer shall show independent testing of acid resistance performance testing.

(f) Membrane Manufacturer shall have available an in-house technical staff to assist the contractor, when necessary, in application of the products and final inspection of the assembly.

(g) Pre-Construction Conferences: The manufacturer shall meet with the necessary parties at the jobsite to review and discuss project conditions as it relates to the integrity of the roofing assembly.

(h) The rubberized asphalt membrane product shall be an environmental-grade product with a minimum 25% post-consumer recycled content. Manufacturer shall provide independent certification of recycled content.

(i) Landscape Installer Qualification: Qualified installer trained by the Garden Roof Assembly system provider who is authorized, approved, or licensed to install the specified products; and who is eligible to receive total system warranty specified.

(j) Garden Roof Assembly Supplier shall show evidence that the specified Garden Roof Assembly has been developed, marketed, supported and installed for a minimum of ten (10) years on projects of similar complexity.

(k) Garden Roof Assembly Supplier shall provide data and calculations, specific to the products being submitted, that verify that the Garden Roof Assembly specified meets the project criteria for storm water runoff volume and rate control.

1. Calculations shall be based on actual testing for supplier's Garden Roof Assembly components to be used for the project including but not limited to the regionally specific growing media formulation and water retention/drainage materials.

2. Calculations shall account for vegetated and un-vegetated portions of the roof as well as local climatic conditions including rainfall depth, intensity, duration, and timing.

(l) Garden Roof Assembly supplier shall provide data demonstrating that the composite C-factor and Curve Number parameters for the specified Garden Roof Assembly are less than or equal to those factors used in the engineering design and analysis for the projects drainage and storm water systems analysis.

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(m) Growing Media Confinement System:

1. Submit current product quality assurance test data and independent laboratory test results indicating compliance with specified performance.

2. Growing media and growing media confinement system shall be supplied by same manufacturer.

3. Garden Roof Assembly Manufacturer will provide load calculations for growing media confinement system. All structural load calculations for the growing media confinement system shall be verified by the Project's structural engineer or architect.

4. The attachment or anchoring of the growing media confinement system to the building structure shall be designed and verified by the Project's structural engineer as adequate for the application.

519.05 Delivery, storage, and handling.

(a) Deliver materials in original unopened containers of packaging clearly labeled with manufacturer's name, brand name, and instructions for use, all identifying numbers, and U.L. labels.

(b) Materials shall be stored in a neat, safe manner, not to exceed the allowable structural capacity of the storage area.

(c) Store materials in a clean, dry area protected from water and direct sunlight.

(d) Store all adhesives at temperatures between 60°F (15.5°C) and 80°F (26.6°C). If exposed to lower temperatures, restore materials to 60°F (15.5°C) minimum temperature before using.

(e) Vegetation shall be handled and stored in accordance with the Garden Roof Assembly Manufacturer's recommendations and guidelines.

519.06 Project Conditions.

(a) Application of the membrane shall not commence nor proceed during inclement weather. All surfaces to receive the membrane shall be free of water, dew, frost, snow and ice.

(b) Application of membrane shall not commence nor proceed when the ambient temperature is below 0°F (17.7°C).

(c) Preparation and application of membrane shall be conducted in well ventilated areas.

(d) Over its service life, do not expose membrane or accessories to a constant temperature in excess of 180°F (82°C) (i.e., hot pipes and vents or direct steam venting, etc.).

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(e) Adhesives contain petroleum distillates and are extremely flammable. Do not breathe vapors or use near an open fire. Do not use in confined areas without adequate ventilation. Consult container or packaging labels and Material Safety Data Sheets (MSDS) for specific safety information.

(f) Do not allow waste products (petroleum, grease, oil, solvents, vegetable or mineral oil, animal fat, etc.) to come in contact with the roof membrane. Any exposure to foreign materials or chemical discharges shall be presented to membrane manufacturer for evaluation to determine any impact on the deck membrane assembly performance.

(g) Condition of concrete deck for application of membrane. The entire deck and the sides of the curbs for a height of 2 inches above the plan thickness of Garden Roof Assemblies shall be free of all foreign material such as dirt, grease, old pavement and primer. All decks shall be sand blasted or shot blasted. Immediately prior to the application of primer or any type of membrane, all dust and loose material shall be removed. The deck condition will be approved by membrane manufacturer before application of membrane.

(h) Contractor shall assure that adequate protection is provided after installation so other trades do not damage membrane.

519.07 Inspection.

(a) The Waterproofing Contractor shall examine all surfaces to receive the waterproofing membrane to verify it is acceptable and proper for the application of the membrane.

(b) The Waterproofing Contractor shall not proceed with the installation of the membrane assembly until all defects have been corrected.

519.08 Preparation.

(a) All surfaces shall be dry, smooth, free of depressions, voids, protrusions, clean and free of unapproved curing compounds, form release agents and other surface contaminants.

1. Cast in-place concrete/Composite deck: All concrete operations shall be performed in accordance with contract documents.

2. Substrate cleaning

A. Thoroughly sweep the substrate which is to receive the roof membrane.

B. Substrate shall also be blown clean using an air compressor to remove any remaining loose debris.

C. If requested by the manufacturer, perform final check to determine if concrete has been properly cleaned by applying a test patch of membrane to the surface and check its adhesion.

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519.09 Installation.

(a) Surface conditioner application (to concrete)

1. Apply a surface conditioner as recommended by the manufacturer and in conformance with ASTM D41 only to concrete using a hand held sprayer evenly at a rate of 300 to 600 SF/gallon (7.4 - 14.7 m2/L) depending on surface texture. Surface conditioner shall "tan" the surface, not blacken it.

2. Allow sufficient time for the surface conditioner to thoroughly dry prior to the membrane application.

(b) Membrane preparation

A. The membrane shall be heated in double jacketed, oil bath or hot air melter with mechanical agitation, specifically designed for the preparation of a rubberized asphalt membrane.

B. Heat membrane until membrane can be drawn-free flowing at a temperature range between 350°F (176°C) and 375°F (190°C).

(c) Detailing/Flashing

1. All detailing and flashing shall be done in accordance with the manufacturer's standard guideline details.

2. All detailing and flashing shall be completed before installing the membrane over the field of the substrate.

3. Install membrane and fabric reinforcing at all joints per plan details prior to full membrane application.

(d) Membrane Application

1. Apply the rubberized asphalt membrane at a rate to provide a continuous, monolithic coat of 90 mil minimum (approximately 2.3 mm), into which is fully embedded a layer of the spunbonded polyester fabric reinforcing sheet, followed by another continuous monolithic coat of membrane at an average thickness of 125 mil (approx. 3.2 mm). Total membrane thickness is to be 215 mils average (approx. 5.5 mm), 180 mils minimum.

2. Overlap fabric reinforcing sheet 1-2 inches (25.4 mm - 50.8 mm) with membrane between sheets.

519.10 Separation/Protection Course Installation.

(a) Separation/Protection course shall be installed as follows:

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1. Embed the *Protection Course / Root Barrier Protection – at Landscape Areas* into the membrane while it is still hot to insure a good bond. Overlap adjoining sheet edges 4 inches (100 mm) and seal the laps with a propane torch.

2. Embed the *Protection Course – at Vehicular Traffic Areas* into the membrane while it is still hot to insure a good bond. Installation of a separation course is necessary in order to carry out the water test. Overlap adjoining sheet edges (dry) a minimum of 2 inch – 3 inch (50.8 mm - 76.2 mm) to insure complete coverage.

519.11 Membrane Integrity Test.

(a) The roof area or portions thereof shall be leak tested by means of electronic testing or by ponding water at a minimum depth of 2 inches (50.8 mm) for a period of 48 hours to check the integrity of the membrane installation. If leaks are observed the water shall be drained completely and the membrane installation repaired.

(b) In the event of excessive damage to the membrane assembly, electronic breach detection testing shall be required prior to the placement of subsequent overburden.

519.12 Drainage, Insulation, and Components Installation.

(a) All Drainage, Geofoam and Components shall be installed outside of Vehicular Traffic Areas per manufacturer's requirements.

(b) Insulation. Where specified, EPS Geofoam insulation shall be installed loose-laid in accordance with manufacturer's recommendations. Connector plates shall be used to restrain EPS Geofoam from moving laterally. A minimum of two plates for each 4'x8' section of EPS block shall be installed to minimize EPS Geofoam block to block movement during installation. Additional plates shall be utilized where multiple layers of EPS Geofoam are utilized as per manufacturer's recommendations.

(c) Hydrodrain Air Layer: Install over the insulation with the filter fabric facing up and the 4 inch overlap of fabric up against the perimeter edge. This fabric overlap should be folded under the core along the perimeter edge. Overlap the 4 inch (100 mm) salvage edge of the geotextile fabric to adjoin sheets and hold in place with duct tape.

(d) Gardendrain Moisture Panels: Install with holes through the dimples on top, over the Hydrodrain Air Layer. Adjacent panels shall be butt together or overlapped approximately 1 inch (25 mm). Cut to fit around penetrations, etc. with a heavy-duty utility knife or small toothed saw. Fill retention cups with Expanded Lightweight Aggregate.

(e) Moisture Retention Mat: Where specified, a layer of Moisture Mat shall be installed over the root barrier (when no insulation is specified) or air layer/ insulation, lapping adjacent rolls a minimum of 4 inches (100 mm). The Moisture Mat shall be turned up all vertical, roofed/flashed surfaces a minimum of 6 inches (150 mm) beyond the anticipated soil level. Any excess shall be trimmed down to the level of the soil.

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(f) Filter Fabric: Install over Gardendrain Moisture Panels, lapping adjacent rolls a minimum of 6 inches (150 mm). Enough material shall be left to be drawn up above the anticipated soil level. Any excess shall be trimmed down to the level of soil.

For slopes ⩾2:12 and <3:12 (approx. 10 - 15°, 17 - 25%) filter fabric shall not be installed over the Gardendrain (only) throughout the field of the roof so that the growing media shall be placed directly into the cups. Filter fabric shall be laid at penetrations, terminations, etc.

(g) Drainage/Soil Confinement System: Place on sloped surfaces per plan details and in accordance with manufacturer's recommendations.

519.13 Hard Scape / Accessory / Ballast Installation.

(a) All drains shall be fitted with inspection/maintenance boxes and grills, built up to ensure access at soil level.

(b) Stone and / or landscape pavement shall be installed at all penetrations, and access hatches and as required for vegetation free zones and as walkway / maintenance paths as shown on the plans.

519.14 Growing Media Installation.

(a) Custom Growing Media Mix (soil) shall be placed carefully to avoid damage or displacement of other materials such as walls, paving, drainage components, filter fabric, and roofing membrane.

(b) Soil shall be placed to within 1 inch greater than final grade or to a depth of no greater than 8 inches and compacted as described in herein. For final grades less than 8 inches only one round of compaction shall be performed and remaining soil loosely placed such that top of soil exceeds final grade by 1 inch. For final grades greater than 8 inches, place soil at no greater than 6 inches and repeat procedure until soil has been compacted within 1 inch of final grade.

(c) Compaction shall be performed with a 200 – 300 lb. landscape roller or lightly compacted with a hand held mechanical compactor to achieve a 50 – 60 % compaction as determined by ASTM D1557.

(d) After compaction remaining soil shall be placed at 1 inch greater than final grade and thoroughly watered or jetted over entire area. Low settled areas shall be filled with additional soil and re-wet to achieve uniform prescribed final grade.

519.15 Vegetation Installation.

(a) Vegetation planting shall be installed in accordance with Garden Roof Assembly manufacturer's recommendations.

(b) Plant materials shall not be installed between the fall frost date and the following spring frost date. Contact Garden Roof Assembly manufacturer for fall and spring frost dates specific to the project and plant material type.

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(c) Growing media shall be thoroughly watered and saturated immediately prior to installing new plant material.

519.16 Vegetation Maintenance.

(a) Contractor shall maintain plantings in accordance with the Garden Roof Assembly manufacturer's Installation and Maintenance Guidelines. Contractor shall contact Garden Roof Assembly manufacturer for specific maintenance requirements.

(b) Maintenance activities shall include, but are not limited to, the following:

1. Periodic on-roof monitoring of vegetation

2. Watering to maintain proper growing media moisture content (especially during periods of hot and dry weather)

3. Weeding to remove unwanted vegetation from planted areas and vegetation free zones.

4. Removal of debris

5. Reporting and photo-documentation of progress of vegetation during maintenance and warranty period

(c) Maintenance shall begin immediately after vegetation installation and shall continue through final acceptance and turn-over of the project to the owner.

(d) Maintenance activities shall continue throughout the two-year warranty period (from date of vegetation installation) to keep vegetation warranty referenced above in effect.

Schedule 10A
APPLICABLE STANDARDS AND SPECIFICATIONS

1. APPLICABLE STANDARDS AND SPECIFICATIONS

a. Subject to Section 8.7, the Developer shall comply with all Construction Standards, including (but, for certainty, not limited to) those listed in this Schedule.

b. The standards are listed in this Schedule by technical discipline for convenience only and, accordingly, such listing shall not be interpreted as limiting the application of such standards only to the specified technical disciplines if they are also applicable to other technical disciplines.

Availability Legend

NS = Document not supplied with RFP

S = Document supplied with RFP

Table 1 General Standards and Specifications

Doc #	Document	Availability
8	**Project Administration**	
10A.8.01	29 CFR 1910, Federal Occupational Safety and Health Standards (General Industry)	NS
10A.8.02	CDOT Project Development Manual	NS
10A.8.03	CDOT Revisions to Project Development Manual	NS
10A.8.04	CDOT Workplace Safety Manual	NS
10A.8.05	FPA 101 Line Safety Code	NS
10A.8.06	International Organization for Standardization	NS
10A.8.07	National Institute of Standards and Specifications	NS
10A.8.08	OSHA Standard Specifications	NS
10.2	**Maintenance of Traffic**	
10A.10.2.01	ATSSA Quality Guidelines for Work Zone Traffic Control Devices	NS
10A.10.2.02	CDOT Construction Detour Standards for Multi-use Trails	NS
10A.10.2.03	CDOT Guidelines for Developing Traffic Incident Management Plans for Work Zones	NS
10A.10.2.04	CDOT Region 1 Lane Closure Strategy	NS
10A.10.2.05	CDOT Safety Guide	NS
10A.10.2.06	CDOT Work Zone Safety and Mobility Rule Procedures Document	NS
10A.10.2.07	CDOT Work Zone Safety Booklet	NS
10.3	**ITS and Tolling Equipment**	

Doc #	Document	Availability
10A.10.3.01	AASHTO Guide for High-Occupancy Vehicle Facilities	NS
10A.10.3.02	AI/EIA/TA 568 A	NS
10A.10.3.03	ANSI/SCTE 77 Specifications for Underground Enclosure Integrity	NS
10A.10.3.04	CDOT ITS Standard Details	NS
10A.10.3.05	Electronic Industries Alliance	NS
10A.10.3.06	Institute of Electrical and Electronics Engineers	NS
10A.10.3.07	Insulated Cable Engineers Association	NS
10A.10.3.08	International Electrotechnical Commission	NS
10A.10.3.09	International Telecommunications Union	NS
10A.10.3.10	National Electrical Manufacturing Association Standards and Specifications	NS
10A.10.3.11	NFPA 70 National Electric Safety Code	NS
10A.10.3.12	NFPA National Electric Code	NS
10A.10.3.13	Rural Utilities Service	NS
10A.10.3.14	Telcordia Technologies	NS
10A.10.3.15	Telecommunications Industry Association	NS
10.4	**Utilities**	
10A.10.4.01	CCD Operating Rules of the Board of Water Commissioners	NS
10A.10.4.02	CCD Rules & Regulations for Governing Sewerage Charges and Fees and Management of Wastewater	NS
10A.10.4.03	CCD Sanitary Sewer Master Plan	NS
10A.10.4.04	CCD Sanitary Sewer Design Technical Criteria Manual	NS
10A.10.4.05	CCD Sanitary Sewer Design Technical Criteria Manual	NS
10A.10.4.06	CCD Wastewater Standard Details	NS
10A.10.4.07	CDOT Utility Accommodation Code	NS
10A.10.4.08	CCD Utility Plan Review	NS
10A.10.4.09	Denver Water Engineering Standards including Materials Specifications and Standard Drawings	NS
10A.10.4.10	Denver Water Capital Projects Construction Standards Volumes I, II, and III	NS
10A.10.4.11	Denver Water Plan Review Guidelines	NS

Doc #	Document	Availability
10A.10.4.12	Wastewater Capital Projects Management Standard Construction Specifications	NS
10A.10.4.13	Wastewater Standard Detail Drawings	NS
10A.10.4.14	Metro Wastewater Reclamation District Rules and Regulations	NS
10A.10.4.15	Metro Engineering Standards	NS
10.5	**Survey**	
10A.10.5.01	CCD Address Assignment Card Entrance Requirements	NS
10A.10.5.02	CCD Easement Relinquishment Entrance Requirements	NS
10A.10.5.03	CCD Guidelines and Requirements for Range Points	NS
10A.10.5.04	CCD Guidelines for Survey Control for Design of City Project	NS
10A.10.5.05	CDOT Survey Manual	NS
10.6	**Roadway Pavements**	
10A.10.6.01	CCD Approved Concrete Mix Designs	NS
10A.10.6.02	CCD Approved List of HMAP Asphalt Mix Designs	NS
10A.10.6.03	CDOT Field Materials Manual	NS
10A.10.6.04	CDOT Laboratory Manual of Test Procedures	NS
10A.10.6.05	CDOT M-E Pavement Design Manual	NS
10A.10.6.06	CDOT Pavement Design Manual	NS
10A.10.6.07	CDOT Field Studies Guidelines	NS
10A.10.6.08	Metropolitan Government Pavement Engineers Council Pavement Design Standards and Construction Specifications	NS
10.8	**Drainage**	
10A.10.8.01	CCD Construction Activities Stormwater Discharge Permit	NS
10A.10.8.02	CCD Construction Activities Stormwater Manual	NS
10A.10.8.03	CCD Storm Drainage Design & Technical Criteria	NS
10A.10.8.04	CCD Storm Drainage Master Plan	NS
10A.10.8.05	CCD Underground Water Quality Devices	NS
10A.10.8.06	CDOT Detour Drainage Structure Design Procedure	NS
10A.10.8.07	CDOT Drainage Design Manual	NS
10A.10.8.08	CDOT Erosion Control & Stormwater Quality Guide	NS

Doc #	Document	Availability
10A.10.8.09	CDOT SWMP Template for Project with 1 Acre or More of Disturbance	NS
10A.10.8.10	CDOT Municipal Separate Storm Sewer (MS4) NPDES Permit	NS
10A.10.8.11	CDOT New Development & Redevelopment Interim Program Guidance as of 3/10/2015	S
10A.10.8.12	CDOT Pipe Material Selection Policy Guide	NS
10A.10.8.13	FEMA Applicable guidelines for LOMR/CLOMR	NS
10A.10.8.14	FEMA Flood Insurance Rate Map	NS
10A.10.8.15	FEMA Flood insurance Study, City and County of Denver, Colorado Volume 1 and 2 (080046V001B)	NS
10A.10.8.16	FHWA HDS No. 5, Hydraulic Design of Highway Culverts	NS
10A.10.8.17	FHWA HEC-11, Design of Riprap Revetment	NS
10A.10.8.18	FHWA HEC-12-Drainage of Highway Pavements	NS
10A.10.8.19	FHWA HEC-13, Hydraulic Design of Improved Inlets for Culverts	NS
10A.10.8.20	FHWA HEC-14, Hydraulic Design of Energy Dissipaters for Culverts and Channels	NS
10A.10.8.21	FHWA HEC-15, Design of Roadside Channels with Flexible Linings	NS
10A.10.8.22	FHWA HEC-18, Evaluating Scour at Bridges	NS
10A.10.8.23	FHWA HEC-20, Stream Stability at Highway Structures	NS
10A.10.8.24	FHWA HEC-21, Design of Bridge Deck Drainage	NS
10A.10.8.25	FHWA HEC-22, Urban Drainage Design Manual	NS
10A.10.8.26	FHWA HEC-23, Bridge Scour and Stream Instability Countermeasures Experience, Selection, and Design Guidance Volume 1 & Volume 2	NS
10A.10.8.27	FHWA HEC-24, Highway Stormwater Pump Station Design	NS
10A.10.8.28	UDFCD Design of Low Tailwater Riprap Basins for Storm Sewer Pipe Outlets	NS
10A.10.8.29	UDFCD Urban Storm Drainage Criteria Manual	NS
10A.10.8.30	UDFCD Flood Hazard Area Delineation	NS
10A.10.8.31	UDFCD Major Drainageway Planning Studies	NS
10A.10.8.32	UDFCD Outfall System Planning Studies	NS
10.9	**Roadway**	
10A.10.9.01	AASHTO A Policy on Geometric Design of Highways and Streets	NS
10A.10.9.02	AASHTO Guide for Development of New Bicycle Facilities	NS

Doc #	Document	Availability
10A.10.9.03	AASHTO Roadside Design Guide	NS
10A.10.9.04	AASHTO Standard Specifications	NS
10A.10.9.05	ADA Accessibility Guidelines	NS
10A.10.9.06	ADA Standards for Accessible Design	NS
10A.10.9.07	ADA Standards for Transportation Facilities	NS
10A.10.9.08	ADA Accessibility Guidelines for Buildings and Facilities	NS
10A.10.9.09	CCD Rules & Regulations for Criteria for Hazardous or Defective Sidewalks	NS
10A.10.9.10	CCD Rules & Regulations for Encroachments in the Public Right of Way	NS
10A.10.9.11	CCD Rules & Regulations for Governing Street Cuts and Roadway Excavation Specifications	NS
10A.10.9.12	CCD Rules & Regulations for Sidewalk and Curb Ramp Construction	NS
10A.10.9.13	CCD Rules & Regulations for Standard Right-of-Way Cross Sections and Utility Locations	NS
10A.10.9.14	CCD Rules & Regulations for the Construction of Curbs, Gutters, Sidewalks, Driveways, Street Paving, and other Public Right-of-Way Improvements	NS
10A.10.9.15	CCD Rules & Regulations Pertaining to the Issuance of Permits by the City Traffic Engineer	NS
10A.10.9.16	CCD Standards and Details for Engineering Division	NS
10A.10.9.17	CCD Transportation Engineering Plan Review Submittal Requirements	NS
10A.10.9.18	CCD Streetscape Design Manual	NS
10A.10.9.19	CCD Amendments to the Building Code for the City and County of Denver	NS
10A.10.9.20	CDOT CADD Manual	NS
10A.10.9.21	CDOT Construction Manual	NS
10A.10.9.22	CDOT Drafting Standards	NS
10A.10.9.23	CDOT Roadway Design Guide	NS
10A.10.9.24	CDOT Standard Plans, M & S Standards	NS
10A.10.9.25	CDOT Standard Specifications for Road and Bridge Construction	NS
10A.10.9.26	CDOT Urban Design Manual	NS
10A.10.9.27	CDOT State Highway Access Code	NS
10.10	**Railroads**	
10A.10.10.01	BNSF Railway – UPRR Guidelines for Railroad Grade Separation Projects	NS

Doc #	Document	Availability
10A.10.10.02	UPRR Guidelines for Preparation of Bridge Demolition and Removal Plan for Structures over Railroad	NS
10.11	**Signing, Pavement Markings, Signalization, and Lighting**	
10A.10.11.01	AI RP-8-00 Illumination Engineering Society of North America	NS
10A.10.11.02	CCD Traffic Signal and Sign & Markings Standards	NS
10A.10.11.03	CCD Street Lighting/Pedestrian Lighting, Design and Review Guidelines	NS
10A.10.11.04	CCD All-Dialectric Loose Tube Fiber Optic Cable	S
10A.10.11.05	CDOT Guide Sign Policy Manual	NS
10A.10.11.06	CDOT Lighting Design Guide	NS
10A.10.11.07	CDOT Retroreflective Sheeting Materials Guide	NS
10A.10.11.08	CDOT Sign Design Manual	NS
10A.10.11.09	CDOT Supplement to Standard Highway Signs	NS
10A.10.11.10	FHWA Manual on Uniform Traffic Control Devices	NS
10A.10.11.11	FHWA Standard Sign	NS
10A.10.11.12	Transportation Research Board Highway Capacity Manual	NS
10A.10.11.13	Xcel Energy Outdoor Lighting Manual	S
10.12	**Cover MEP System**	
10A.10.12.01	AMCA 250, Laboratory Methods of Testing Jet Tunnel Fans for Performance	NS
10A.10.12.02	AMCA 300 Reverberant Room Method for Sound Testing	NS
10A.10.12.03	ANSI/IESNA RP-22-11 Tunnel Lighting	NS
10A.10.12.04	ANSI/UL 2196 Tests for Fire Resistive Cables	NS
10A.10.12.05	ASHRAE LV-11-C076: Impact of Tunnel Ventilation on Tunnel Fixed Fire Suppression System.	NS
10A.10.12.06	ASHRAE LV-11-C077: Advanced Analysis Techniques in the Design of Longitudinal Tunnel Ventilation System Using Jet Fans	NS
10A.10.12.07	ASHRAE LV-11-C078: Assessing the Impact Fire Heat Release Rate has on Infrastructure Design and Constructability of Rail and Road Tunnels Ventilation Systems	NS
10A.10.12.08	ASHRAE OR-05-15-3: Investigation of Effectiveness of Emergency Ventilation Strategies in the Event of Fires in Road Tunnels	NS
10A.10.12.09	ASHRAE standards	NS
10A.10.12.10	ASTM E 119, Standard test Methods for Fire Tests of Building Construction and Materials	NS
10A.10.12.11	ASTM E 136, Standard test method for behavior of materials in a vertical tube furnace at 750°C	NS

Doc #	Document	Availability
10A.10.12.12	ASTM E 2652 Standard test method for behavior of materials in a tube furnace with a cone-shaped airflow stabilizer at 750°C	NS
10A.10.12.13	CIE 088 Guide for the Lighting of Road Tunnels and Underpasses	NS
10A.10.12.14	CIE 88. Guide for the Lighting of Road Tunnels and Underpasses.	NS
10A.10.12.15	Engineering Guidance for Water Based Fire Fighting Systems for a comprehensive evaluation of tunnels with fixed firefighting systems, scientific report of the SOLIT research project, prepared by the SOLIT consortium	NS
10A.10.12.16	Engineering Guidance for Water Based Fire Fighting Systems for a comprehensive evaluation of tunnels with fixed firefighting systems, Scientific report of the SOLIT research project, prepared by the SOLIT consortium	NS
10A.10.12.17	FHWA Road Tunnel Design Guidelines	NS
10A.10.12.18	FHWA Systems Engineering Guidebook for Intelligent Transportation Systems	NS
10A.10.12.19	FT4/IEEE 1202 Standard for Flame Propagation Testing of Wire and Cable	NS
10A.10.12.20	IEC 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems	NS
10A.10.12.21	IEC61508 Functional safety of electrical/electronic/ programmable electronic safety – related systems	NS
10A.10.12.22	IESNA LM 79 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products	NS
10A.10.12.23	IESNA LM 80 Approved Method: Measuring Lumen Maintenance of LED Light Sources + Addendum A	NS
10A.10.12.24	IESNA TM-21 Projecting Long Term Maintenance of LED Light Sources	NS
10A.10.12.25	ISO 1182 Reaction to fire tests for building and transport products - Non-combustibility tests	NS
10A.10.12.26	ISO/IEC 27001 Information technology -- Security techniques -- Information security management systems – Requirements	NS
10A.10.12.27	ISO/TR 13387 Part 1 Fire Safety Engineering. Application of fire performance concepts to design objectives	NS
10A.10.12.28	ISO/TR 13387 Part 2 Fire Safety Engineering. Design Fire Scenarios and Design Fires	NS
10A.10.12.29	ISO/TR 13387 Part 3 Fire Safety Engineering	NS
10A.10.12.30	ISO/TR 13387 Part 3 Fire Safety Engineering. Assessment and Verification of mathematical fire models	NS
10A.10.12.31	ISO/TR 13387 Part 4 Fire Safety Engineering. Initiation and development of fire and generation of fire effluents	NS
10A.10.12.32	ISO/TR 13387 Part 5 Fire Safety Engineering. Movement of fire effluents	NS
10A.10.12.33	ISO/TR 13387 Part 6 Fire Safety Engineering. Structural Response and fire spread beyond the enclosure of origin	NS
10A.10.12.34	ISO/TR 13387 Part 7 Fire Safety Engineering. Detection, Activation and Suppression	NS
10A.10.12.35	ISO/TR 13387 Part 8 Fire Safety Engineering. Life safety- occupant behavior, location and condition	NS

Doc #	Document	Availability
10A.10.12.36	MIL-C-24643 General Specification for Cable and Cords, Electrical, Low Smoke, for Shipboard Use	NS
10A.10.12.37	NFPA 1 Fire Code	NS
10A.10.12.38	NFPA 10 Standard for Portable Fire Extinguishers	NS
10A.10.12.39	NFPA 13 Standard for the installation of Sprinkler Systems	NS
10A.10.12.40	NFPA 14 Standard for the installation of standpipe and hose systems	NS
10A.10.12.41	NFPA 15 Standard for Water Spray Fixed Systems for Fire Protection	NS
10A.10.12.42	NFPA 18 Standard on Wetting Agents	NS
10A.10.12.43	NFPA 20 Standard for the installation of stationary pumps for fire protection	NS
10A.10.12.44	NFPA 22 Standard for Water Tanks for private Fire protection	NS
10A.10.12.45	NFPA 24 Standard for the installation of private fire service mains and the appurtenances	NS
10A.10.12.46	NFPA 25 Standard for Inspection, Testing, and Maintenance of Water-Based Fire protection Systems	NS
10A.10.12.47	NFPA 72 National Fire Alarm and Signaling Code	NS
10A.10.12.48	NFPA 80 Standard for Fire Doors and Other Opening Protectives	NS
10A.10.12.49	NFPA 92 Standard for Smoke Control Systems	NS
10A.10.12.50	NFPA 101 Life Safety Code	NS
10A.10.12.51	NFPA 110 Standard for Emergency and Standby Power Systems	NS
10A.10.12.52	NFPA 111 Standard on Stored Electrical Energy Emergency and Standby Power Systems	NS
10A.10.12.53	NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations	NS
10A.10.12.54	NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces	NS
10A.10.12.55	NFPA 502 Standard for Roads, Tunnels, Bridges, and Other Limited Access Highways	NS
10A.10.12.56	NFPA 750 Standard on Water Mist Fire Protection Systems	NS
10A.10.12.57	NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities	NS
10A.10.12.58	NFPA 1561 Standard on Emergency Services Incident Management	NS
10A.10.12.59	NFPA 1963 Standard for fire hose connections	NS
10A.10.12.60	PIARC 2008 R07. Road Tunnels: An Assessment of fixed firefighting systems and any such update, replacements or revisions published in the period before the completion of the design	NS
10A.10.12.61	PIARC 2008 R07. Road Tunnels: An Assessment of fixed firefighting systems (or any update, revision or replacement document published)	NS
10A.10.12.62	UL Subject 1724 Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems	NS

Doc #	Document	Availability
10.13	**Structures**	
10A.10.13.01	AASHTO Guide Design Specifications for Bridge Temporary Works	NS
10A.10.13.02	AASHTO Guide Specifications for Design and Construction of Segmental Concrete Bridges	NS
10A.10.13.03	AASHTO Interim Mechanistic Empirical Pavement Design Guide Manual of Practice	NS
10A.10.13.04	AASHTO LRFD Bridge Construction Specifications	NS
10A.10.13.05	AASHTO LRFD Bridge Design Specifications	NS
10A.10.13.06	AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges	NS
10A.10.13.07	AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals	NS
10A.10.13.08	AASHTO Manual for Bridge Evaluation	NS
10A.10.13.09	AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals	NS
10A.10.13.10	AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing	NS
10A.10.13.11	AASHTO Steel Bridge Fabrication Guide Specification	NS
10A.10.13.12	AASHTO Technical Manual for Design and Construction of Road Tunnels – Civil Elements	NS
10A.10.13.13	AASHTO/AWS D1.5 M/D 1.5, Bridge Welding Code	NS
10A.10.13.14	AASHTO/NSBA Shop Detail Drawing Review/Approval Guidelines	NS
10A.10.13.15	AREMA Manual for Railway Engineering	NS
10A.10.13.16	ASTM American Society for Testing and Materials	NS
10A.10.13.17	ASTM D-1143	NS
10A.10.13.18	ASTM D-3996	NS
10A.10.13.19	ASTM Standard Specification Manual	NS
10A.10.13.20	CDOT Bridge Design Manual	NS
10A.10.13.21	CDOT Bridge Detail Manual	NS
10A.10.13.22	CDOT Bridge Fabrication Inspection Manual	NS
10A.10.13.23	CDOT Bridge Rating Manual	NS
10A.10.13.24	CDOT Bridge Technical Memorandums	NS
10A.10.13.25	CDOT Structural Worksheets	NS
10A.10.13.26	FHWA DP-90-068, Permanent Ground Anchors, Volume 1, Final Report	NS

Doc #	Document	Availability
10A.10.13.27	FHWA HI-95-038 Geosynthetic Design and Construction Guidelines	NS
10A.10.13.28	FHWA IF-99-015 Geotechnical Engineering Circular No. 4 – Ground Anchors and Anchored Systems	NS
10A.10.13.29	FHWA NHI-00-043 Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines	NS
10A.10.13.30	FHWA NHI-09-087 Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes	NS
10A.10.13.31	FHWA NHI-14-067 Geotechnical Engineering Circular No. 7 – Soil Nail Walls	NS
10A.10.13.32	FHWA NHS-10-024 and Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Volume I	NS
10A.10.13.33	FHWA NHS-10-025 and Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Volume II	NS
10A.10.13.34	FHWA RD-73-93, Analysis and Design Problems in Modeling Slurry Wall Construction	NS
10A.10.13.35	FHWA RD-80-047, Slurry Walls as an Integral Part of Underground Transportation Structures	NS
10A.10.13.36	FHWA RD-82-046, Tiebacks, Executive Summary	NS
10A.10.13.37	FHWA RD-82-047, Tiebacks	NS
10A.10.13.38	FHWA RD-89-93, Soil Nailing for Stabilization of Highway Slopes and Excavations	NS
10A.10.13.39	FHWA RD-92-004, Drilled Shafts for Bridge Foundations	NS
10A.10.13.40	FHWA SA-00-043, Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines	NS
10A.10.13.41	FHWA SA-93-068, Soil Nail Field Inspectors Manual – Soil Nail Walls	NS
10A.10.13.42	FHWA SA-96-069R Manual for the Design & Construction Monitoring of Soil Nail Walls	NS
10A.10.13.43	International Building Code	NS
10A.10.13.44	NCHRP Report 402, Fatigue Design of Modular Bridge Expansion Joints, Appendix A & Appendix B	NS
10A.10.13.45	NCHRP Report 483: Bridge Life-Cycle Cost Analysis	NS
10.14	**Landscaping and Aesthetics**	
10A.10.14.01	CCD Denver Parks + Recreation Planning, Design + Construction Standards	NS
10A.10.14.02	Approved Street Tree List for Denver's Public Rights-of-way	NS
10A.10.14.03	CDOT Landscape Architecture Manual	NS
10A.10.14.04	Denver Public School Design and Construction Standards	NS
10A.10.14.05	AI Z60.1, American Standards for Nursery Stock	NS
14	**Strategic Communications**	
10A.14.01	CDOT The Colorado Brand Guidelines	NS

Doc #	Document	Availability
17	**Environmental Requirements**	
10A.17.01	CDOT Functional Assessment of Colorado Wetlands (FACWet) methodology	NS
10A.17.02	CDOT Wetland Program Book	NS
10A.17.03	CDOT Checklist for Wetland Finding and Wetland Finding Amendments	NS
10A.17.04	CDOT Noise Analysis and Abatement Guidelines	NS
10A.17.05	CDOT Traffic Noise Model User's Guide for Colorado DOT Projects	NS
10A.17.06	CDOT Noise Program Book	NS
10A.17.07	CDOT Impacted Black-Tailed Prairie Dog Policy	NS
10A.17.08	CDOT Environmental Stewardship Guide	NS
10A.17.09	CDOT NEPA Manual	NS
10A.17.10	CDOT Reevaluation Form No. 1399	NS
10A.17.11	CDOT Guidelines for Senate Bill 40 Wildlife Certification	NS
10A.17.12	CDOT Guidance for Filling Out CDOT Form 1399	NS
10A.17.13	CDOT Air Quality Monitoring Plan Template	NS
10A.17.14	CDOT Air Quality Monitoring, Maintenance, and Mitigation Template	NS
10A.17.15	CDOT Procedures for Hazardous Material Spills that Occur on State and Federal Highways Within Colorado as a Result of a Highway Transportation Incident	NS
10A.17.16	Colorado Weed Management Guide	NS
10A.17.17	Approved Street Tree List for Denver's Public Rights-of-way	NS
10A.17.18	FHWA Highway Construction Noise Handbook	NS
10A.17.19	FHWA Highway Traffic Noise: Analysis and Abatement Guidance	NS
10A.17.20	National Arbor Association Ref. 1. Pruning Standards for Shade Trees	NS
10A.17.21	USACE Wetland Delineation Manual	NS
18	**Right-of-Way**	
10A.18.01	23 CFR 645 Utilities & 23 CFR 646 Railroads	NS
10A.18.02	23 CFR 710.313	NS
10A.18.03	23 CFR 711 & 23 CFR 774	NS
10A.18.04	CDOT Right of Way Manual	NS

Doc #	Document	Availability
10A.18.05	CFR sec. 650.101 through 650.209, Code of Federal Regulations	NS
10A.18.06	CRS 24-56-101, The Colorado Relocation Assistance and Land Acquisition Policy, et seq. as supplemented	NS
10A.18.07	Federal Register, Proposed Rules, December 21, 1992	NS
10A.18.08	The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended	NS
10A.18.09	United States Access Board, Revised Draft Guidelines for Accessible Public Rights-of-Way	NS

2. APPENDICES

Appendix A Modifications to Standard Specifications

Appendix A

Modifications to CDOT Standard Specifications

1. GENERAL

1.1 This Appendix sets forth modifications to the CDOT *Standard Specification for Road and Bridge Construction* ("CDOT *Standard Specifications*"), as well as Standard Special Provisions applicable to the Project. For certainty, the CDOT *Standard Specifications* (as so modified) and the Standard Special Provisions listed in Section 4 below are Construction Standards for the purposes of the definition thereof in Part A of Annex A (Definitions and Abbreviations) to the Project Agreement. The provisions of this Section 1 shall also apply to the Project Special Provisions set out in Appendix A to any Section of Schedule 10.

1.2 Subject to Sections 1.3, 1.4, 1.5, 1.6 and 1.8 of this Appendix, all references to "Engineer" in the CDOT Standard Specifications (as incorporated into the Project Agreement by the terms of this Appendix) shall be deemed to be references to the Developer, unless the context requires otherwise.

1.3 When the CDOT Standard Specifications (as incorporated into the Project Agreement by the terms of this Appendix) describe actions, materials, means or methods that are required and that are qualified by phrases such as: "as directed by the Engineer", "when directed by the Engineer", "as determined by the Engineer", "with or without permission of the Engineer", "in the opinion of the Engineer", "unless authorized by the Engineer", "satisfactory to the Engineer", "as approved by the Engineer", or "unless another type is specified or is permitted with approval of the Engineer", such phrases shall be disregarded.

1.4 When the CDOT Standard Specifications (as incorporated into the Project Agreement by the terms of this Appendix) refer to "Resident Engineer", "Agricultural Engineer", "Bridge, Construction or Maintenance Engineer", "TMC system inspector", "Concrete Engineer", "Project Engineer", "Materials Engineer", "Commissioner", "Structural Metals Engineer", "Department's Lighting Engineer", "Geotechnical Engineer" or any other specific Department special engineer, such references shall be deemed to be references to "the Department".

1.5 When the CDOT Standard Specifications (as incorporated into the Project Agreement by the terms of this Appendix) require an approval, acceptance, consent, approval or like assent of the Engineer or the Department for the use of alternative or substituted processes or components, references to "the Engineer" shall be disregarded.

1.6 If the CDOT Standard Specifications (as incorporated into the Project Agreement by the terms of this Appendix) require an approval, acceptance, consent, approval or like assent of any correction or repair that deviates from the requirements of the Project Agreement, such Approval, Acceptance, consent, approval or like assent must be given by the Department.

1.7 When the CDOT Standard Specifications (as incorporated into the Project Agreement by the terms of this Appendix) provide that reports, records or other documents shall be submitted to the Department or to the Engineer, such reports shall be required to be submitted to the Department only.

1.8 When the CDOT Standard Specifications (as incorporated into the Project Agreement by the terms of this Appendix) require actions, materials, means or methods that are "either as indicated in the Plans or as designated by the Engineer", the phrase "or as designated by the Engineer" shall be disregarded.

1.9 When the CDOT Standard Specifications (as incorporated into the Project Agreement by the terms of this Appendix) require any approvals, acceptances, consents, approvals or like assent to be given by the Department or the State, any references to the State shall be disregarded.

1.10 To the extent that there is any ambiguity as to the interpretation of the CDOT Standard Specifications (as incorporated into the Project Agreement, and as modified, by this Appendix), Section 2.4.4 of the Project Agreement shall apply.

2. Division 100 of the CDOT Standard Specifications

Division 100 of the CDOT *Standard Specifications* is not incorporated into the Project Agreement by this Appendix except to the extent expressly specified in this sub-section 2.

[*To be provided in subsequent Addendum.*]

3. DIVISIONS 200 TO 700 OF THE CDOT STANDARD SPECIFICATIONS

Divisions 200 through 700 are incorporated by reference into the Project Agreement except (1) as otherwise provided in the Project Agreement and (2) in Divisions 200 through 600, the method of measurement and basis of payment provisions shall not be incorporated into the Project Agreement. Any reference to a specific section of Divisions 200 to 700 in this Schedule 10 shall be deemed to be a reference to that section as modified by this Appendix and any other part of Schedule 10 where that section is modified.

4. CDOT STANDARD SPECIAL PROVISIONS

The following Standard Special Provisions are attached hereto and incorporated by reference into the Project Agreement as revisions to the CDOT *Standard Specifications*. Any reference to "Contractor" in these Standard Special Provisions (as so incorporated) shall be deemed to be references to the "Developer".

STANDARD SPECIAL PROVISIONS

	Date	**No. of Pages**
Revision of Section 203 – Imported Material for Embankment	(Feb 3, 2011)	2
Revision of section 203, 206, 304, and 613 – Compaction	(Jul 19, 2012)	2
Revision of Section 206 – Imported Material for Structure Backfill	(Jul 19, 2012)	2
Revision of Section 206 – Structure Backfill (Flowfill)	(Apr 26, 2012)	2
Revision of Section 206 – Structure Backfill at Bridge Abutments	(Jan 30, 2014)	1
Revision of Sections 206 and 601 – Backfilling Structures that Support Lateral Earth Pressures	(Jul 29, 2011)	1
Revision of Section 208 – Aggregate Bag	(Jan 31, 2013)	1
Revision of Section 208 – Erosion Control Supervisor	(Apr 30, 2015)	1
Revision of Section 208 – Erosion Log	(Jan 31, 2013)	1
Revision of Section 212 – Seed	(Apr 26, 2012)	1
Revision of Section 213 – Mulching	(Jan 31, 2013)	4
Revision of Section 216 – Soil Retention Covering	(July 16, 2015)	6
Revision of Section 250 – Environmental, Health, and Safety Management	(Jan 15, 2015))	14
Revision of Sections 304 and 703 – Aggregate Base Course (RAP)	(Oct 31, 2013)	1
Revision of Section 401 – Compaction of Hot Mix Asphalt	(Apr 26, 2012)	1

	Date	No. of Pages
Revision of Section 401 – Compaction Pavement Test Section (CTS)	(Jul 19, 2012)	1
Revision of Section 401 – Composition of Mixtures – Voids Acceptance	(Feb 3, 2011)	1
Revision of Section 401 – Plant Mix Pavements	(Feb 3, 2011)	1
Revision of Section 401 – Reclaimed Asphalt Pavement	(May 2, 2013)	2
Revision of Section 401 – Temperature Segregation	(Feb 3, 2011)	1
Revision of Section 401 – Tolerances for Hot Mix Asphalt (Voids Acceptance)	(Jan 6, 2012)	1
Revision of Sections 401 and 412 – Safety Edge	(May 2, 2013)	2
Revision of Sections 412 – Portland Cement Concrete Pavement Finishing	(Feb 3, 2011)	1
Revision of Sections 412, 601, and 711 – Liquid Membrane-Forming Compounds for Curing Concrete	(May 5, 2011)	1
Revision of Sections 412 and 705 – Preformed Compression Seals	(Feb 3, 2011)	2
Revision of Section 504 – Concrete Block Facing MSE Wall	(Feb 3, 2011)	13
Revision of Section 504 – Concrete Panel Facing MSE Wall	(Feb 3, 2011)	12
Revision of Section 507 - Grouted Riprap Slope and Ditch Paving	(Nov 6, 2014)	1
Revision of Sections 507, 601, and 606 – Macro Fiber-Reinforced Concrete	(May 2, 2013)	1
Revision of Section 510 – Structural Plate Structures	(Feb 3, 2011)	1
Revision of Section 512 – Bearing Device Testing	(Nov 6, 2014)	1
Revision of Section 518 – Bridge Expansion Device	(Oct 31, 2013)	1
Revision of Section 601 Class H and HT Bridge Deck Concrete	(May 16, 2013)	4
Revision of Section 601 – Concrete Batching	(Feb 3, 2011)	1
Revision of Section 601 – Concrete Finishing	(Feb 3, 2011)	1
Revision of Section 601 – Concrete Form and Falsework Removal	(Jul 28, 2011)	2
Revision of Section 601 – Concrete Slump Acceptance	(Jul 29, 2011)	1
Revision of Section 601 – Depositing Concrete Under Water	(May 2, 2013)	1

	Date	No. of Pages
Revision of Section 601 – Entrained Air of Class B Z Concrete	(April30, 2015)	1
Revision of Section 601 – Fiber-Reinforced Concrete	(May 2, 2013)	1
Revision of Section 601 – QC Testing Requirements for Structural Concrete	(May 8, 2014)	1
Revision of Section 601 – Structural Concrete Strength Acceptance	(April 30,2015)	1
Revision of Section 601 – Cements and Pozzolans	(Nov 6, 2014)	4
Revision of Section 603 – Culvert Pipe Inspection	(Oct 2, 2014)	1
Revision of Section 603, 624, 705, 707, and 712 – Drainage Pipe	(April 30,2015)	3
Revision of Section 612 – Delineators	(Feb 3, 2011)	1
Revision of Section 612 – Flexible Delineators	(Jul 19, 2012)	1
Revision of Sections 613 and 715 – LED Roadway Luminaire	(Jan 30, 2014)	5
Revision of Section 614 – Accessible Pedestrian Signal	(Nov 1, 2012)	3
Revision of Section 614 – Blank Out Sign (LED) (Speed Radar)	(Dec 29, 2011)	6
Revision of Section 614 – Pedestrian Push Button Assembly	(Jul 19, 2012)	1
Revision of Section 618 – Prestressed Concrete	(Apr 26, 2012)	24
Revision of Section 620 – Field Laboratories with Ignition Furnace	(Feb 3, 2011)	1
Revision of Section 627 and 708 – Pavement Marking Paint	(Jan 31,2013)	2
Revision of Section 630 – Emergency Pull-off Area (Temporary)	(May 5, 2011)	1
Revision of Section 630 – Retroreflective Sign Sheeting	(May 8, 2014)	1
Revision of Section 702 – Hot Poured Crack Sealant	(Sep 29, 2011)	1
Revision of Section 703 – Aggregate for Bases	(Oct 31, 2013)	1
Revision of Section 703 – Aggregate for Hot Mix Asphalt	(Nov 1, 2012)	2
Revision of Section 703 – Aggregate for Stone Matrix Asphalt	(Apr 26, 2012)	1
Revision of Section 703 – Concrete Aggregate	(Jul 28, 2011)	1
Revision of Section 703 – Mineral Filler	(May 8, 2014)	1
Revision of Section 712 – Geotextiles	(Nov 1, 2012)	2

	Date	No. of Pages
Revision of Section 712 – Water for Mixing or Curing Concrete	(Feb 3, 2011)	1
Revision of Section 713 - Epoxy Pavement Marking	(Jan 15, 2015)	2
Revision of Section 713 – Reflectors for Delineators and Median Barrier	(May 2, 2013)	1
Revision of Section 713 – Sign Panel Backgrounds	(Nov 6, 2014)	1

SCHEDULE 10B
CONTRACT DRAWINGS

Availability Legend

NS = Document not supplied with RFP

S = Document supplied with Draft RFP

Date Issued: Date the document was listed or supplied with the RFP

Doc #	Document	Date Issued	Availability
10.9	**Roadway**		
10B.10.9.01	Roadway Typical Sections	9/29/2015	S
10.10	**Railroads**		
10B.10.10.01	UPRR 100% Package: UPRR 36th Yard Track Relocation Plans		S
10B.10.10.02	BNSF 100% Package: BNSF Market Lead Relocation Plans		S
10.11	**Signing, Pavement Markings, Signalization, and Lighting**		
10B.10.11.01	I-70 East Ramp Metering Assessment	9/29/2015	S
10.13	**Structures**		
10B.10.13.01	Structure Typical Sections	9/29/2015	S
10.14	**Landscaping and Aesthetics**		
10B.10.14.01	Conceptual Master Plan Exhibit	9/29/2015	S
10B.10.14.02	Landscaping Details for Irrigated Areas		S
10B.10.14.03	Bridge Aesthetic Design Details		S
10B.10.14.04	Wall Aesthetic Design Details		S
18	**Right-of-Way**		
10B.18.01	Right-of-Way Exhibits City and County of Denver	9/29/2015	S
10B.18.02	Right-of-Way Exhibits Onsite Outfall System	9/29/2015	S
10B.18.03	Right-of-Way Exhibits Private Ownership	9/29/2015	S

Schedule 11
Operations and Maintenance Requirements

1. GENERAL OPERATIONS AND MAINTENANCE REQUIREMENTS

1.1 General Requirements

1.1.1 Developer shall perform the O&M Work in accordance with the requirements of this Schedule 11. Developer shall ensure that the Project is operated, maintained and managed in a safe, effective, and reliable level of operation and condition for the duration of the O&M Period During Construction and the Operating Period.

1.1.2 All requirements in this Schedule 11 are applicable throughout the O&M Period During Construction and the Operating Period, unless otherwise specifically stated.

1.1.3 Developer Responsibility to Implement and Report Unplanned Closures

Without prejudice to Developer's obligations under Sections 4.2.2 through 4.2.4 of this Schedule 11 or any other provisions of this Agreement relating to Emergencies or Incidents, if Developer becomes aware of an Emergency, an Incident, a Defect, or any other hazard as a result of which the normal use of any part of the Project would compromise the safety of Users, Developer shall immediately implement a Closure or other action necessary to mitigate the hazard. Regardless of the circumstances, Developer shall immediately inform the Department of the circumstances of any such Closure and shall coordinate with the Department, and other relevant Governmental Authorities that may be impacted by such Closure. The provisions of this Section 1.1.3 are without prejudice to the provisions of Schedule 6 (*Performance Mechanism*) and Section 2 of Schedule 10 (*Design and Construction Requirements*), including, for certainty, if any Closure implemented by Developer pursuant to this Section 1.1.3 is a Non-Permitted Closure (a) as a result of such Closure resulting in a breach of, or is not permitted by, any of Sections 2.5, 2.6 or 2.11 of Schedule 10 (*Design and Construction Requirements*) or (b) for any other reason.

1.1.4 Developer shall ensure that all surplus materials arising from the O&M Work be disposed of at such places as may lawfully be used for disposal, and shall comply with all Law in relation to ensuring that such materials will not cause or give rise to pollution of the Environment in contravention of any Environmental Law.

1.1.5 Standards

Subject to Section 8.6, in performing the O&M Work Developer shall comply with the Project Standards, including (but, for certainty, not limited to):

a. in performing the Renewal Work, the Construction Standards (including those listed in Schedule 10A (*Applicable Standards and Specifications*)) to the extent applicable to the Renewal Work; and

b. in performing any other O&M Work, the following documents as they are referenced in this Schedule 11:

   i. CDOT Bridge Rating Manual;

   ii. CDOT Distress Manual for HMA and PCC Pavements;

   iii. CDOT Erosion Control & Stormwater Quality Guide;

   iv. CDOT Highway Maintenance Levels of Service Manual;

   v. CDOT M&S Standard Plans;

   vi. CDOT Pavement Management Manual;

   vii. CDOT Pontis Bridge Inspection Coding Guide;

   viii. CDOT Roadside Vegetation Management (Final Guideline Document);

   ix. CDOT Signs and Signals Coding Guide;

x. FHWA Bridge Inspector Reference Manual;

xi. FHWA Highway and Rail Transit Tunnel Inspection Manual;

xii. FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual;

xiii. FHWA National Bridge Inspection Standards (NBIS);

xiv. FHWA Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual;

xv. Manual of Uniform Traffic Control Devices (MUTCD), including the Colorado Supplement;

xvi. National Electric Code (NEC);

xvii. National Electric Safety Code (NESC);

xviii. National Fire Protection Association (NFPA); and

xix. Other referenced AASHTO, ASTM and FHWA standards and manuals.

2. O&M SCOPE AND LIMITS DURING CONSTRUCTION

2.1 O&M Limits During Construction

2.1.1 Developer shall perform O&M Work During Construction within the O&M Limits During Construction in accordance with this Section 2 and the other provisions of this Schedule 11 that apply during the O&M Work During Construction Period.

2.1.2 Developer shall submit O&M Limits During Construction drawings to, and obtain Approval thereof from, the Department prior to NTP2. The O&M Limits During Construction drawings produced by Developer shall (a) include the Site for the entire length of the Project, (b) reference the O&M Limits Reference Drawings, and (c) comply with the requirements of this Section 2 and other provisions of this Schedule 11 that apply during the O&M Work During Construction Period. The drawings shall clearly detail Developer's responsibilities and interface of operations and maintenance activities performed by others, and shall be presented in both detailed plans and cross section drawings. The drawings shall also be consistent with Developer's design, and shall additionally be updated for Approval as required during the Construction Period to reflect changes to the as-built Project.

2.2 O&M Scope During Construction

During the O&M Period During Construction, Developer shall comply with the following obligations set out in this Section 2.2.

2.2.1 I-70 Mainline

Developer shall perform:

a. the O&M Work, excluding Renewal Work, of the I-70 Mainline including but not limited to all roadway lanes, ramps, shoulders, roadside Elements, walls and structures from the I-25/I-70 interchange to I-70 East/Brighton Boulevard interchange and from I-70/Chambers Road interchange to I-70 /Tower Road interchange in accordance with the Performance Requirements set out in Schedule 11 Appendix A-1;

b. the O&M Work, including Renewal Work, of the I-70 Mainline including but not limited to all roadway lanes, ramps, shoulders, roadside Elements, walls and structures from the I-70/Brighton Boulevard interchange to the I-70/Chambers Road interchange in accordance with the Performance Requirements set out in Schedule 11 Appendix A-1.

2.2.2 Local Agency Infrastructure

During the Construction Period, Developer shall perform:

a. O&M Work (except Incident response, sweeping and cleaning and Snow and Ice Control Services) on Local Agency Roadways and all infrastructure Elements owned by Local Agencies;

b. Incident response, sweeping and cleaning and (after the date of issuance of NTP3) Snow and Ice Control Services on those Local Agency Roadways, or portions thereof, or on structures owned by a Local Agency where it has a Construction Work and/or a street occupancy Permit in relation to such Local Agency Roadway, or portion thereof, or such structure, as well as being responsible for meeting all other conditions of the relevant Permit; and

c. any other O&M Work as may be required by the terms of any such street occupancy Permit.

2.2.3 Drainage System

Developer shall perform the O&M Work of the Onsite Outfall System and the Offsite Outfall System.

2.2.4 Water Quality

Developer shall comply with the conditions of the most current version of the Department's MS4 permit, including inspections and annual reporting requirements, at the Setting Date. Developer shall furnish the required documents per the permit to the Department for Acceptance. The required annual report shall be submitted to the Department for Acceptance by December 31st of each Calendar Year.

2.2.5 [Maintenance Yard[1]

a. It has been agreed that Developer will use the existing maintenance yard at Havana Street (the "Maintenance Yard") to facilitate its performance of the O&M Work.

b. Developer shall perform O&M Work of the Maintenance Yard and associated facilities that are used by Developer to meet the requirements of Schedule 11 throughout the O&M Period During Construction and Operating Period.

c. Developer shall comply with all applicable environmental requirements with respect to the use of the Maintenance Yard, and shall ensure no increase of contamination occurs from Developer's use of the Maintenance Yard.]

2.2.6 ITS and Tolling Equipment

Developer shall perform O&M Work with respect to ITS and tolling equipment in accordance Section 3 (*ITS and Tolling Equipment*) of Schedule 10 (*Design and Construction Requirements*).

2.3 **Baseline Inspections and Baseline Asset Condition Report**

2.3.1 Developer shall:

a. carry out inspections and tests to determine the existing condition of each Element of the Project to be maintained by Developer during the O&M Period During Construction pursuant to this Schedule 11 (the "Baseline Inspections"); and

b. prepare a report (the "Baseline Asset Condition Report (BACR)"), which shall:

i. list in detail all the Elements to be maintained by Developer during the O&M Period During Construction;

ii. assess and describe the existing condition of all Elements that are to be maintained during the O&M Period During Construction, which description and condition assessment reporting shall:

[1] Note to Proposers: This provision and any other references to the Maintenance Yard will only be included in the Project Agreement if Preferred Proposer elects to use the Maintenance Yard.

A. be in reference to CDOT's Highway Level of Service Manual; and

B. at a minimum, include, but not be limited to, the Elements to be maintained as listed in Appendix A-1 of this Schedule 11, referencing additionally any other assessment criteria identified in Appendix A-1;

iii. by updating the Performance and Measurement Table set out in Appendix A-1 to this Schedule 11, list the Target minimum baseline asset condition in accordance with which such Elements will be maintained by Developer during the O&M Period During Construction, which such Target minimum baseline condition shall allow for the safe and reliable operation of the existing asset and shall meet or exceed the existing condition of the relevant Element, except to the extent that a Target is specified for such Element in Appendix A-1 of this Schedule 11, in which instance the specified Target condition shall be the minimum baseline asset condition.

2.3.2 Developer shall submit the proposed scope of the Baseline Inspections it intends to carry out, together with the methodology proposed and the list of qualified testing organizations in carrying out the proposed scope ("Baseline Asset Condition Inspection Plan") to, and obtain the Acceptance thereof from, the Department prior to NTP2. Following Acceptance by the Department of the Baseline Asset Condition Inspection Plan, Developer shall provide to the Department a minimum of ten Working Days' notice prior to the commencement of the Baseline Inspections.

2.3.3 After carrying out the Baseline Inspections, Developer shall submit the Baseline Asset Condition Report (BACR) to, and obtain the Acceptance thereof from, the Department prior to NTP2. The Accepted BACR shall be an appendix to the Maintenance Management Plan submitted to the Department pursuant to Section 5 of this Schedule 11.

3. O&M SCOPE AND LIMITS AFTER CONSTRUCTION

3.1 O&M Limits After Construction

3.1.1 Developer shall perform O&M Work After Construction within the O&M Limits After Construction in accordance with this Section 3 and the other provisions of this Schedule 11 that apply during the Operating Period.

3.1.2 Developer shall submit O&M Limits After Construction drawings to, and obtain the Approval thereof from, the Department prior to Substantial Completion. The O&M Limits After Construction drawings produced by Developer shall (a) include the Site for the entire length of the Project, (b) reference the O&M Limits Reference Drawings, and (c) comply with the requirements of this Section 3 and other provisions of this Schedule 11 that apply during the Operating Period. The drawings shall clearly detail Developer's responsibilities and interface of operations and maintenance activities performed by others, and shall be presented in both detailed plans and cross section drawings. The drawings shall reflect the as-built condition of the Project.

3.2 O&M Scope After Construction

During the Operating Period, Developer shall comply with the following obligations set out in this Section 3.2.

3.2.1 I-70 Mainline

Developer shall perform:

a. the O&M Work, excluding Renewal Work, of the I-70 Mainline including but not limited to all roadway lanes, ramps, shoulders, roadside elements, walls and structures from the I-25/I-70 interchange to I-70 /Brighton Boulevard interchange and from I-70/Chambers Road interchange to I-70/Tower Road interchange in accordance with the Performance Requirements set out in Schedule 11 Appendix A-2;

b. the O&M Work, including Renewal Work, of the I-70 Mainline including but not limited to all roadway lanes, ramps, shoulders, roadside Elements, walls and structures from the I-

70/Brighton Boulevard interchange to the I-70/Chambers Road interchange in accordance with the Performance Requirements set out in Schedule 11 Appendix A-2.

3.2.2 Local Agency Infrastructure

After Substantial Completion, Developer shall perform:

a. O&M Work (except Incident response, sweeping and cleaning and Snow and Ice Control Services) on all crossing road structures that connect to Local Agency Roadways (with the exception of signage, traffic signals, lighting, pavement marking, and aesthetic elements on such structures that are owned by the Local Agency);

b. Incident response, Snow and Ice Control Services and sweeping and cleaning for Local Agency Roadways and crossing road structures where Developer is performing Renewal Work thereon and/or where Developer has an active street occupancy permit with the Local Agency, as well as being responsible for meeting all other conditions of the relevant Permit; and

c. any other O&M Work as may be required by the terms of any such street occupancy Permit.

3.2.3 Cover

a. Developer shall perform O&M Work of all Elements of the Cover, including but not limited to all structural Elements, drainage Elements, foundation Elements, all mechanical and electrical Elements, and all fire and life safety equipment, except for urban and landscaped features on top of the Cover. This includes the operation, maintenance, and monitoring of the Command Control and Monitoring System (CCMS) as described in Section 12 (*Cover MEP System*) of Schedule 10 (*Design and Construction Requirements*) in relation to the Cover and immediate approaches, and the provision of the Control Center with dedicated staff trained on the CCMS.

b. Developer shall be required to interface with the Department in respect of operations of the ITS associated with the Cover.

c. Developer shall interface with the relevant Local Agency's fire department with respect to the maintenance and operation of fire detection and firefighting equipment.

3.2.4 Railway Structures

Developer shall perform the O&M Work on Railroad structures in compliance with the RRAs. The maintenance of the tracks and signals shall not be Developer's responsibility.

3.2.5 Utility Infrastructure

Developer shall be responsible for O&M Work of any structures constructed by Developer to carry utility infrastructure.

3.2.6 Drainage System

Developer shall perform the O&M Work of the Onsite Outfall System and the Offsite Outfall System.

3.2.7 Water Quality Facilities

The Developer shall comply with the conditions of the most current version of the Department's MS4 permit, including inspections and annual reporting requirements, at the Setting Date. Developer shall furnish the required documents per the permit to the Department for Acceptance. The required annual report shall be submitted to the Department for Acceptance by December 31st of each Calendar Year.

3.2.8 ITS and Tolling Equipment

a. Developer shall be responsible for O&M Work of the ETC civil infrastructure installed by the Developer.

b. Developer's responsibility for O&M Work with respect to ITS and tolling equipment shall be in accordance with Appendix B of Section 3 of Schedule 10 (*Design and Construction Requirements*).

c. For the duration of the period commencing at the operation of the Developer installed ITS equipment up to two years following Final Acceptance, Developer shall identify and appoint a person qualified in installing, maintaining, troubleshooting, and repairing the ITS equipment and communications infrastructure.

3.2.9 Costs for Utility Services

a. Department will be responsible for Utility services costs associated with the operation of the ITS equipment.

b. Local Agency will be responsible for Utility services costs for traffic signals (other than the signals at I-70/Chambers Road interchange), lighting, and irrigation.

c. Department will be responsible for Utility services costs for traffic signals at the I-70/Chambers Road interchange.

d. Except as required in Sections 3.2.9.a to 3.2.9.c above, Developer shall be responsible for all other costs for Utility services to the Site, including for clarity, the Utility services costs required to operate and maintain the Control Center, the equipment associated with the Cover, any required pump stations and pump equipment, and the Developer's maintenance facilities [(including the Maintenance Yard)].

3.2.10 Landscaped and Vegetated Areas

a. Developer shall perform the O&M Work of all landscaped and vegetated areas on the Site, with the exception of any landscaped areas on top of the Cover.

4. PERFORMANCE REQUIREMENTS AND RESPONSIBILITIES

Developer shall be responsible for and shall take all necessary actions to ensure that all Defects are remedied to allow for the safe, effective and reliable operation of the Project. Developer shall ensure that every Element identified in Appendix A of this Schedule 11 (as updated in accordance with, respectively, Sections 2.3.1.b.iii and 4.2.7.a of this Schedule 11) is in a condition that meets or exceeds the Performance Requirements as set forth in Appendix A-1 to Schedule 11 during the O&M Period During Construction and Appendix A-2 to Schedule 11 (in each case, as updated in accordance with this Schedule 11) during the Operating Period.

4.1 Categorization of Defects

4.1.1 Developer shall employ personnel who are trained to make the appropriate categorization of Defects and maintain a record of the circumstances of the Defect and how it was categorized.

4.1.2 Whenever a Defect is identified, Developer shall make a determination as to whether it is

a. a Category 1 Defect, in which event Developer shall take all necessary action to mitigate and remedy the Defect in accordance with Sections 4.2.2 or 4.2.3, as applicable, of this Schedule 11; or

b. a Category 2 Defect, in which event Developer shall take all necessary action to mitigate and remedy the Defect in accordance with Section 4.2.4 of this Schedule 11.

4.2 Performance and Measurement Mechanism

The Performance and Measurement Tables assign the following obligations to Developer for each Element during the O&M Period During Construction and the Operating Period, as applicable.

4.2.1 General Requirements

Developer shall take action to ensure that each Element complies with the General Requirements applicable to such Element during the O&M Period During Construction and the Operating Period.

4.2.2 Category 1 – Immediate Action

a. The first sub-column of the "Defect Remedy Period" column in the Performance and Measurement Tables is entitled "Cat. 1 Immediate Action" and sets out, for each Element, the maximum time period following the time when Developer first becomes (or should have become) aware of the existence of the relevant Defect within which Developer shall take and complete action that will mitigate a Category 1 Defect in such manner that the immediate or imminent hazard, nuisance and/or risk that caused it to be a Category 1 Defect is alleviated.

b. Such action may be a temporary repair or a permanent repair depending on the nature of the Defect and the operational impact of performing the repair Work within the applicable Defect Remedy Period specified for Cat 1 – Immediate Action.

4.2.3 Category 1 – Permanent Remedy

The second sub-column of the "Defect Remedy Period" column in the Performance and Measurement Tables is entitled "Cat 1 Permanent Remedy" and sets out, for each Element, the maximum time period following the time when Developer first becomes (or should have become) aware of the existence of the relevant Defect within which Developer shall take and complete action to effect a permanent repair of a Category 1 Defect.

4.2.4 Category 2 – Permanent Repair

The third sub-column of the "Defect Remedy Period" column in the Performance and Measurement Tables is entitled "Cat. 2 Permanent Repair" and sets out, for each Element, the maximum time period following the time when Developer first becomes (or should have become) aware of the existence of the relevant Defect within which Developer shall complete a permanent repair of a Category 2 Defect. Developer shall monitor Category 2 Defects and shall not allow a Category 2 Defect to deteriorate into a Category 1 Defect.

4.2.5 Measurement Criteria

The first column under the heading "Performance Requirements" is entitled "Measurement Criteria" and sets out, for each Element, the criteria by which the condition of each Element is to be measured.

4.2.6 Target

The second column under the heading "Performance Requirements" is entitled "Target" and sets out, for each Element, a threshold for each of the specified Measurement Criteria. A Defect shall be deemed to exist if the measured value applicable to any of the Measurement Criteria does not meet or exceed the threshold identified as the Target condition.

4.2.7 Updates to Performance Requirements during the Operating Period

a. Developer may submit to the Department for Approval proposed updates, if any, to the Performance and Measurement Table set out in Appendix A-2 to this Schedule 11 no later than 90 Calendar Days before the then anticipated Substantial Completion Date to reflect Good Industry Practice and specific attributes of Developer's final plan set (for example, where the final plan set incorporates a feature that is not included as an Element in such Performance and Measurement Table). Developer may thereafter submit to Department for Approval any proposed updates no later than 60 Calendar Days before the start of each subsequent Contract Year to reflect Good Industry Practice.

b. The Department shall be entitled at any time to require Developer to adopt amendments to any of the Performance Requirements in such Performance and Measurement Table

where such amendments are required to comply with then-current Good Industry Practice. The Department shall require the adoption of a new Target in the Performance Requirements only when this is required because the measurement scale associated with the original "Measurement Criteria" is superseded because it no longer complies with Good Industry Practice. The new Target shall be determined using the principle that compliance with the new Target shall achieve the same standard of performance, frequency of O&M Work and User satisfaction as would have been achieved through Developer's compliance with the original Measurement Criteria and Target. For example, the Department may require skid resistance to be reported using a different measurement scale from that in current use and would be entitled (subject to calibration between new and old measurement scales to demonstrate equivalence of performance, frequency of O&M Work and User satisfaction) to require the adoption of an amendment to both the Measurement Criteria and Target for this Element.

5. MAINTENANCE MANAGEMENT PLAN

5.1 General

5.1.1 Developer shall prepare a Maintenance Management Plan (MMP) that is consistent with its maintenance obligations under this Schedule 11 and that defines the processes and procedures for complying with its maintenance obligations.

5.1.2 Developer shall provide, and keep updated, processes and procedures in the MMP to ensure that:

a. all Elements meet or exceed the applicable General Requirements and Performance Requirements; and

b. all required action is taken and completed in relation to Defects within the applicable Defect Remedy Periods.

5.1.3 Developer shall submit the MMP to, and obtain the Acceptance thereof from, the Department prior to NTP2 with focus on Construction Period responsibilities, and shall submit an updated version to the Department for Acceptance by the Department prior to Substantial Completion with focus on Operating Period responsibilities. In addition, the MMP shall be updated and submitted for Acceptance annually no later than 60 Calendar Days before the start of each Contract Year. The MMP shall also be updated more frequently as required during the Construction Period or Operating Period to indicate changes to relevant protocols, agreements, and other interactions with other entities and to indicate requirements for equipment and systems that have been revised, upgraded, or replaced. Developer shall at all times comply with the latest Accepted MMP.

5.2 Maintenance Management Plan Contents

5.2.1 The MMP shall include at a minimum:

a. A complete organizational chart and staffing plan that shows the personnel including the O&M Manager required for all maintenance activities including Routine Maintenance and Renewal Work; Emergencies; inspections; and management. A contact list shall be provided. Personnel qualifications for each position, required training, anticipated work hours, and work locations including personnel training requirements for operating in traffic zones shall be included;

b. The experience and qualification requirements for personnel to be engaged in all inspection work setting out training that is to be provided for all aspects of inspections including as a minimum specialist inspections (e.g. Cover), routine inspections, and safety related inspections;

c. Developer's O&M Safety Plan that complies with the requirements of Section 5.3 of this Schedule 11, including procedure for providing Project-specific safety training for all personnel engaged in maintenance and inspection activities for the Project;

d. Developer's O&M Quality Management Plan (OMQMP) setting out arrangements for quality management and assurance that complies with the requirements of Section 5.4 of this Schedule 11;

e. Drawings delineating the O&M Limits During Construction and O&M Limits After Construction and detailing the limits of infrastructure to be maintained by the Department or by the relevant Local Agency;

f. Location and layout of maintenance and storage facilities, vehicles and equipment, tools, computers, software and other major assets/items including procedures for ensuring all necessary maintenance equipment and materials are readily available;

g. Procedure for communications and coordination with the Department for scheduling repairs and Closures for maintenance, including minimum time period of notification to the Department on scheduled repairs or Closures;

h. Procedure for coordination of activities, including repairs/renewals/replacements and Closures, with other entities having interests within and adjacent to the Project, including Utilities;

i. Approach to the identification and recording of Defects and their repair including the approach and training of personnel in the correct assignment of "Category 1 – Immediate Action", "Category 1 – Permanent Remedy", "Category 2 – Permanent Repair" Defect status including procedures and scheduled frequency of safety inspections;

j. Procedures for responding in a timely manner to Category 1 Defects and Category 2 Defects;

k. Procedures for monitoring and maintaining the condition and performance of the Project to meet the General Requirements, the Performance Requirements and Defect Remedy Periods and updates thereof. Procedures shall include the inspection routines, checklists, frequency for each of the inspection routines, and equipment and tools needed for the inspections. The MMP shall set forth the conditions where the frequency of inspections for a particular asset, component or group of assets may be increased due to the ageing of an asset or increased wear and tear;

l. Reference to procedures for traffic control and management during periods of Closures, with inclusion or reference to Transportation Management Plan and maintenance of traffic requirements in Section 2 (*Maintenance of Traffic*) of Schedule 10 (*Design and Construction Requirements*) in respect of O&M Work During Construction and, in respect of O&M Work After Construction, the same requirements as if they applied to O&M Work After Construction;

m. Procedure for investigation and response to complaints or reports of Defects or Noncompliance Events received from the Department or other sources;

n. Work plans and schedules for undertaking Routine Maintenance activities and Renewal Work during the O&M Period During Construction based on the Baseline Asset Condition Report and during the Operating Period based on routine inspections, which plans and schedules shall include the information required by Section 5.2.2 of this Schedule 11;

o. Description of Developer's approach to life cycle assumptions and Renewal Work and interfaces with the Renewal Work Plan during the O&M Period During Construction based on the Baseline Asset Condition Report and during the Operating Period based on routine inspections;

p. Procedure for record keeping according to Developer's MQMP;

q. Procedure for tracking Defects, performance compliance and corrections (repairs, renewal, replacements);

r. Procedure for maintaining a comprehensive, accurate, and auditable spare parts and inventory level to address the maintenance obligations. This information contained in the inventory shall be compatible with the Maintenance Management Information System (MMIS) as described in this Schedule 11;

s. Description of Developer's MMIS and its functionality;

t. Details and steps of transition of maintenance activities from the Department or Local Agency necessary to achieve a seamless transition to Developer, and to allow for continuity of service (24 hours per day, seven days per week, and every day of the year) to Users. The details and steps shall outline any phased transition of operations and maintenance activities, including anticipated timeline of such phased transition;

u. Maintenance and service manuals including detailed technical and servicing descriptions for all Elements assessed as well as software and equipment that is required for the O&M Work. The manual shall include preventative maintenance schedules, testing and diagnostic procedures, trouble-shooting techniques, corrective measures, both temporary and permanent, the location and availability of support services, point to point component wiring schematics and logic signal flows, and assembly and disassembly drawings, including exploded view drawings. Standard service manuals for unmodified commercial products are acceptable for inclusion in the MMP provided that they contain details and accurate information in order to properly service the specific equipment related to the Elements. The manual in relation to the Cover MEP System shall comply with the requirements for the Operations and Maintenance Manual that is required in accordance with Section 12 of Schedule 10 (*Design and Construction Requirements*);

v. Description of all Elements, including an inventory of facilities, systems and equipment to be maintained by Developer, including a logical system breakdown of all Elements, including facilities, equipment and systems and the levels of maintenance and summary of maintenance tasks to be provided by Developer;

w. List of the maintained Elements major systems and equipment manufacturers/vendors, including their contact information (contact person, address, telephone numbers, website address and e-mail address);

x. A list of unplanned but anticipated maintenance services for all road Elements;

y. Repair procedures for repairs that are anticipated;

z. Inclusion or reference to activities necessary to comply with Schedule 17 (*Environmental Requirements*);

aa. Inspection plan and copies of all inspection forms and checklists; and

bb. How best management practices will be applied;

5.2.2 The MMP shall include Developer's schedules and associated plans for Routine Maintenance and Renewal Work. These schedules and plans shall set forth the type of O&M Work, anticipated timing, durations, frequency of each task, intended traffic management arrangements, and reporting requirements. Maintenance schedules shall include:

a. Monthly Routine Maintenance Schedule;

b. Annual Routine Maintenance Schedule;

c. Annual Renewal Work Schedule, which shall be consistent with the Renewal Work Plan; and

d. Five Year Renewal Work Schedule, which shall be consistent with the Renewal Work Plan.

5.2.3 The MMP shall include the latest versions of:

a. The Performance Requirements in the form most recently Accepted by the Department following the procedure for updates to the Performance and Measurement Tables in accordance with Section 4.2.5 of this Schedule 11, if applicable; and

b. The actual Useful Life for each Renewal Element, which such document shall reflect the Useful Life Baseline Requirements Table in the form most recently Accepted by the Department following the procedure for updates to the Useful Life Baseline Requirements Table as set forth in Section 6.1.4 of this Schedule 11.

5.2.4 The MMP shall include the following appended Plans:

a. Baseline Asset Condition Report;

b. Renewal Work Plan;

c. O&M Safety Plan; and

d. O&M Quality Management Plan (OMQMP).

5.3 O&M Safety Plan

As part of the MMP, Developer shall provide an O&M Safety Plan that demonstrates compliance with all State, Federal and local codes and regulations for the protection of personnel and Users during the performance of O&M Work. Developer shall develop a Safety Plan that includes staff training, safety procedures and protocols to address hazardous conditions associated with the O&M Work.

a. Developer is responsible for ensuring that all equipment used shall be maintained in a safe and efficient manner in accordance with all State, local and federal laws, safety organizations, regulations and guidelines pertaining to providing the required services.

b. Developer shall follow all safety requirements outlined in the National Electric Safety Code (NESC), the Occupational Safety and Health Administration (OSHA) rules, and any applicable standards or practices for safe installation or maintenance of required equipment.

5.4 O&M Quality Management Plan

5.4.1 As part of the Maintenance Management Plan, Developer shall provide an O&M Quality Management Plan (OMQMP). The Department will use the OMQMP to monitor Developer's performance of the O&M Work. The OMQMP shall address each of the following:

a. Approach to quality management including a description of quality assurance and quality control functions for validating the information, accuracy, and results of the OMQMP;

b. A quality improvement process used to analyze Nonconforming Work and determine methods or processes to minimize or eliminate Noncompliance Events associated with O&M Work;

c. Approach to reporting relationships and responsibilities including Department oversight;

d. Approach to Developer self-monitoring/self-reporting requirements for inspection, data validation procedures and tracking of Nonconforming Work;

e. Approach to preparing and reviewing Incident reports, non-conformance reports, traffic reports and maintenance work reports;

f. A comprehensive records and document management system to provide access to records and to govern protocols for records retention. Developer shall prepare reports that provide summary of observations and identify the results from the OMQMP processes.

6. RENEWAL WORKS REQUIREMENTS

6.1 **Renewal Work Plan**

6.1.1 Developer shall prepare and submit a Renewal Work Plan as part of the MMP that shall be updated annually with the MMP. The Renewal Work Plan shall provide a detailed approach for Renewal Work that includes maintenance, repair, reconstruction, and replacement of each applicable Element, which shall be identified and scheduled in an annual Renewal Work Schedule and a rolling five year Renewal Work Schedule to be updated annually with the MMP.

6.1.2 The Renewal Work Plan shall identify Developer's procedure for evaluating the condition of the Project, identification of needs for Renewal Work, the identification and reporting of the status of assets under the control of Developer and Developer's procedures for implementing Renewal Work based on the expected Useful Life of each of the Elements.

6.1.3 The following information shall be provided in the Renewal Work Plan:

a. Developer's overall approach to meeting Renewal Work requirements, and expected Renewal Work expenditure throughout the remainder of the Term;

b. Developer's procedure for optimizing the Useful Life of each Element, describing how the replacement cycle is determined based upon initial cost; maintenance cost; reliability; obsolescence; and other relevant factors;

c. Developer's annual update to the Useful Life Baseline Requirements Table. For each Renewal Element, Developer shall provide evidence based upon actual performance and condition in service, together with appropriate operations and maintenance records, that the Useful Life as set forth in the Useful Life Baseline Requirements Table will be met or exceeded;

d. Developer's procedure for assessing the condition of all Elements, including the critical structural Elements, against intended performance and predicting time to maintenance and Residual Life, including the inspection, testing and monitoring requirements;

e. Demonstration that Developer's approach to Renewal Work is aligned with Good Industry Practice. Developer is required to keep up to date with the latest techniques and research in life cycle maintenance and to demonstrate that all such innovation and research is adopted as warranted in its annual updates of the Renewal Work Plan;

f. Developer's procedure for the selection of suppliers and subcontractors needed to perform Renewal Work, including supply chain management procedures and procedures in place to ensure that quality of work for any Renewal Work is assured;

g. Staffing, organization and specific responsibilities for implementing the requirements for Residual Life Methodology and testing as required by Schedule 12 (*Handback Requirements*);

h. Developer's plan to achieve Handback Requirements for all Elements;

i. The methods and procedures to be used by Developer to estimate the expected cost of Renewal Work for each asset and component, demonstrating that the estimates are reasonable and appropriate; and

j. Planned Closures in order to conduct the Renewal Work, to be updated more frequently as required.

6.1.4 Updates to the Useful Life Baseline Requirements

Developer may submit proposed updates to the Useful Life Baseline Requirements Table to the Department for Approval no later than 90 Calendar Days before the then anticipated Substantial Completion Date, to reflect Good Industry Practice and specific attributes of Developer's final plan set (for example, where the final plan set incorporates a feature that is not included as a Renewal Element in the Useful Life Baseline Requirements Table), and thereafter no later than 60 Calendar Days before the end of each Contract Year. For each Renewal Element, the Department may take into consideration evidence based upon actual performance and condition

in service, together with appropriate operations and maintenance records when considering a request by Developer to increase the Useful Life of any Renewal Element.

6.2 **Annual Renewal Work Schedule**

6.2.1 Not later than 60 Calendar Days before the end of each Contract Year, Developer shall prepare and submit to the Department for Acceptance a detailed annual Renewal Work Schedule for the following year consistent with, and including in respect of such year all information required in accordance with Section 6.3 of this Schedule 11 to be included in, the current five year Renewal Work Schedule.

6.2.2 Developer shall perform the Renewal Work as planned to maintain compliance with the Performance Requirements.

6.3 **Five Year Renewal Work Schedule**

6.3.1 Not later than 60 Calendar Days before the end of each Contract Year, Developer shall prepare and submit to the Department for Acceptance a five year Renewal Work Schedule that identifies Developer's rolling five year plan for performing Renewal Work.

6.3.2 Developer shall use the results of all inspections and other relevant information to determine the Residual Life of each Element of the Project to demonstrate how the Handback Requirements will be met. The five year Renewal Work Schedule shall identify any necessary Routine Maintenance to be carried out according to an optimized replacement and renewal cycle such that Renewal Work is performed in accordance with this Section 6.

6.3.3 The five year Renewal Work Schedule shall include by Element:

a. The estimated Residual Life of each Residual Element and the proposed strategy and activities that will be carried out to meet the Handback Requirements;

b. The performance of the Renewal Elements, including any instances where a Renewal Element has not achieved its originally intended Useful Life;

c. A description of any Routine Maintenance required to ensure that each Element of the Project continues to meet or exceed the Performance Requirements;

d. A description of the type of Renewal Work anticipated to be performed at the end of the Element's Residual Life; and

e. A schedule of anticipated planned maintenance needed to perform the Renewal Work including the nature, timing and duration of any associated Closures.

6.4 **General Renewal Work Obligations**

6.4.1 Developer shall perform Renewal Work whenever any one or more of the following conditions applies:

a. Any Element is subject to deterioration that will or is reasonably likely to result in imminent or repeated failure to comply with the Performance Requirements;

b. A Defect exists and Renewal Work is needed in order to ensure that Developer complies with its obligations under any of Sections 4.2.2, 4.2.3 or 4.2.4 of this Schedule 11;

c. A Category 2 Defect exists and Renewal Work is needed to avoid the Defect from deteriorating to a Category 1 Defect;

d. Any Element ceases to function, or dies (as in the case of certain landscaping); and/or

e. The frequency of repair is greater than the frequency of preventative maintenance recommended in the manufacturer's preventive maintenance schedule.

6.4.2 Developer shall perform all Renewal Work in accordance with the provisions of this Agreement relating to the performance of Construction Work that are applicable to the relevant item of Renewal Work, including compliance with associated maintenance of traffic requirements

(provided that, for certainty, the provisions of Schedule 6 (*Performance Mechanism*) relating to Non-Permitted Operating Period Closures shall apply and not the provisions thereof relating to Non-Permitted Construction Closure Deductions) and the provisions listed in Section 6.4.3 below.

6.4.3 Such provisions shall include:

a. The terms and procedures set forth in this Agreement that relate to Deliverables in respect of Construction Work;

b. The terms and procedures that relate to performance, design and construction standards in force at the time of the design of the Renewal Work;

c. All quality assurance and quality control provisions set forth in Schedule 8 (*Project Administration*);

d. Developer's obligation to employ an engineer licensed in Colorado to perform specified duties; and

e. The Department's rights to oversee and audit the Renewal Work.

7. MAINTENANCE MANAGEMENT INFORMATION SYSTEM

7.1.1 Developer shall implement a computer-based Maintenance Management Information System (MMIS) to record inventory, failures, repairs, maintenance activities and inspections performed. Developer shall enter all infrastructure Elements into the MMIS with associated identifications (IDs) consistent with those descriptions and units of measure used by the Department. Developer shall record all information in a consistent manner and shall ensure that all information is searchable by individual attribute. The Department shall have read-only remote access to the MMIS. The information contained in the MMIS shall be provided in exportable format to allow pertinent information to be included in the Department's maintenance system.

7.1.2 Developer shall include relevant information in the MMIS including, but not limited to, the following for each and every Element to be maintained, as appropriate:

a. location, accurate to within one foot in 20 feet

b. equipment nomenclature;

c. serial number;

d. name;

e. date of installation;

f. technician identification;

g. type of failure;

h. date and time of failure;

i. date and time of response to the site;

j. date and time of return to service;

k. preventive maintenance work;

l. scheduled work;

m. work repair code;

n. failure and repair history;

o. statistical data on mean time between failure and mean time to repair; and

p. Closure log by time and location;

7.1.3 Developer shall also keep records of labor hours, expended materials, quantity and equipment types as well as the hours that the equipment was in operation. This information may be in CDOT component numbers or class code numbers.

7.1.4 Developer shall configure the MMIS to report work by Department function code, infrastructure Element, reference marker, crew and unit of measurement. In the MMIS, the information for bridges shall include National Bridge Inventory (NBI) sheets.

7.2 Geographical Reporting in the MMIS

7.2.1 The MMIS shall be capable of reporting system performance on a geographical basis to demonstrate compliance with operational and maintenance requirements. Within the MMIS, Developer shall incorporate a Geographical Information System (GIS), which shall use the same database engine as the MMIS and shall use the MMIS for display of Element information. All infrastructure Elements shall be identified on the MMIS.

7.2.2 The information displayed geographically shall include pavement condition measurements, maintenance limits, average daily traffic and truck counts, work performed by roadway segment, type of work, crew/contractor, and any other information relevant to the operation, maintenance and renewal of the infrastructure Elements.

7.3 Creation, Updating and Hand Over of the MMIS

7.3.1 Developer shall fully populate and make operational the MMIS prior to NTP2 and shall keep the MMIS updated and operational for the duration of the O&M Period During Construction and the Operating Period. Developer shall provide equipment, facilities and training necessary to permit remote, real-time, dedicated high-speed access to the MMIS, via one terminal each, for the Department. Developer shall provide an operating manual ('MMIS Operating Manual') and provide full demonstration of the functionality of the MMIS to the Department for Acceptance prior to NTP2.

7.3.2 When an infrastructure Element is constructed, installed, maintained, inspected, modified, replaced or removed, Developer shall update the MMIS within three Calendar Days of completion of such work. Developer shall record Category 1 Defects and Category 2 Defects on the MMIS within three Calendar Days of them coming to the attention of Developer. Developer shall record all other required information within 15 Calendar Days after completion or occurrence of the relevant activity.

7.3.3 Developer shall hand over the fully populated MMIS and everything required for its operation to Department, or other entity as directed by the Department, at the Expiry Date (or, if earlier, the Termination Date).

8. INSPECTIONS

8.1 General Requirements

8.1.1 Developer shall carry out inspections and continuous monitoring of all infrastructure Elements in accordance with the MMP. Developer shall use the results of inspections to develop and update the MMP, including the Renewal Work Plan, and to develop programs of maintenance and Renewal Work to minimize the occurrence of Defects and impacts to Users and to ensure that Developer is meeting or exceeding the Performance Requirements. Developer shall cause trained and competent personnel to plan and implement a program of inspections of infrastructure Elements which:

a. verifies the continuing safety of the infrastructure Elements for Users;

b. prioritizes Category 1 Defects;

c. identifies Category 2 Defects to be included for repair either within Developer's annually recurring highway maintenance and repair program or as Renewal Work;

d. is responsive to reports or complaints received;

e. takes account of Incidents and Emergencies affecting the infrastructure Elements;

f. monitors the effects of extreme weather conditions and Precipitation Events; and

g. collects data to monitor performance of infrastructure Elements and to establish priorities for future maintenance operations and Renewal Work.

8.2 **Inspection Frequency**

Developer shall annually review and update as necessary the schedule for inspections which will be appropriately spaced throughout the year. After periods of inclement weather or other events which may cause accelerated deterioration of assets, safety hazards or other detrimental impacts to the infrastructure Elements, Developer shall conduct comprehensive visual surveys which will identify all such areas of concern.

8.3 **General Inspections**

8.3.1 Developer shall perform general routine inspections in accordance with the MMP in order to identify and mitigate all Defects. Operations and maintenance records in respect of general inspections shall include details of the manner of inspection (e.g. types of Closures), the weather conditions and any other unusual features of the inspection. Developer shall perform general routine inspections such that Category 2 Defects are identified and repaired within the applicable Defect Remedy Period. Defects which require Specialist Inspections to identify them may have different identification periods.

8.3.2 Developer shall use the results of the inspections described in its MMP and other relevant information to determine, on an annual basis, or more frequently, the Useful Life and Residual Life of each applicable Element. Developer shall use this information to update the scope of the Renewal Work Plan.

8.4 **Specialist Inspections**

Developer shall undertake Specialist Inspections for infrastructure Elements listed, at a minimum, in Table 11-1 below and shall include the inspection results as operations and maintenance records.

Table 11-1 – Specialist Inspections

Element	Frequency
Roadway	Annual survey of pavement condition for the I-70 Mainline, CDOT Roadways and Local Agency Roadways within the O&M Limits at the time of the survey and all infrastructure Elements undertaken using automated condition survey equipment to measure all necessary criteria including: ruts, cracking, faulting, skid resistance and ride quality (IRI) according to the inspection and measurement methods set forth in Appendix A-1 and A-2
Bridges and structures	Inspections and load rating calculations at the frequency specified in Appendix A-1 and A-2. In addition, NBIS inspections as per FHWA regulations and at the frequency specified in FHWA regulations, CDOT Pontis Bridge Inspection Coding Guide, and AASHTO Manual for Condition Evaluation of Bridges.
Electrical supplies to lighting, signs, traffic signals and communications equipment	Inspections as required by FHWA, electrical regulations, as well as all current Department M&S Standard Plans.

Element	Frequency
Mechanical, electrical, or plumbing equipment, including those associated with the Cover	Inspections as required by the MMP, the equipment manufacturer, and this Project Agreement.

8.5 **Roadway Condition Monitoring**

The Department will conduct a routine annual roadway condition survey as part of the Department statewide annual pavement condition data collection services performed by a contracted service provider. Data collected, at a minimum, will include the following:

a. International Roughness Index (IRI) using AASHTO Standard Practices PP50-07, PP49-07, and RR43M/R43-7;

b. Rutting using a 5-laser sensor rut bar in accordance with AASHTO PP38-00;

c. Maximum faulting and average faulting for 1/10-mile segments measured in accordance with AASHTO R36-04; and

d. Cracking Distress in accordance with Distress Identification Manual for Long-term Pavement Management Performance Project (FHWA-RD-03-031). This routine annual pavement condition survey will serve as a quality control check of Developer in order to ensure that Developer is consistently monitoring the pavement condition in accordance with this Agreement.

The Department may conduct additional monitoring at any time in accordance with, and as and when permitted by, the provisions of the Project Agreement.

9. OPERATIONS MANAGEMENT PLAN

9.1 **General**

9.1.1 Developer shall prepare the Operations Management Plan (OMP) to meet the operating requirements set forth in this Schedule 11 and shall include information regarding the procedures for the O&M Period During Construction and the Operating Period.

9.1.2 Developer shall submit the OMP to, and obtain the Acceptance thereof from, the Department prior to NTP2 with focus on O&M Period During Construction responsibilities, and shall submit an updated version to the Department for Acceptance by the Department prior to Substantial Completion with focus on Operating Period responsibilities. In addition, the OMP shall be updated and submitted for Acceptance annually no later than 60 Calendar Days before the end of each Contract Year. The OMP shall also be updated more frequently as required, during the Construction Period or the Operating Period to indicate changes to relevant protocols, agreements, and other interactions with other entities and to indicate requirements for equipment and systems that have been revised, upgraded, or replaced. Developer shall comply with the latest Accepted OMP.

9.2 **OMP Contents**

9.2.1 Developer shall prepare the OMP in a manner which shall include and set forth in detail, at a minimum, the approach, procedures, and implementation for the following:

a. Overview description of all facilities, systems and equipment to be operated by Developer;

b. Organizational structure to ensure 24 hour response to Incidents and Emergencies;

c. Monitoring the safety and operational performance of the Project;

d. Staffing plan procedures, including staff qualifications, training and certification processes;

e. Incident response, management and reporting;

f. Traffic operations restrictions, including permitted Closure hours;

g. Description of how operations performance monitoring will be accomplished;

h. Establishment of plans and procedures in meeting notification and database requirements in compliance with Part 6 (*Reporting Requirements*) of Schedule 6 (*Performance Mechanism*);

i. Operating protocols, agreements and interactions with the various entities and agencies with interests in the Project, including the Tolled Express Lanes;

j. Standard operating and communication procedures for emergency preparation, response, and recovery, including impacts from extreme weather conditions;

k. Planning and coordination with all affected Governmental Authorities, including Emergency Services;

l. Liaison and coordination with the Colorado Traffic Management Center or any other entities that may establish traffic management centers in the area;

m. Analysis of vehicular accident patterns to identify safety issues and implement cost effective solutions to maximize safety;

n. Identification, containment and disposal of Hazardous Substances spills with reports to the Department;

o. Prompt investigation of reports or complaints received from all sources;

p. Establishment of procedures for external communication system messaging resulting in improved dissemination of information and safety notices in reference to, and in compliance with, the requirements of Schedule 14 (*Strategic Communications*);

q. Establishment of guidelines and procedures for handling system failures and ensuring that all failures are properly documented;

r. Staff qualifications, equipment availability, response and cleanup as a result of fuel spills or other contamination-causing events;

9.2.2 The OMP shall include the following appended Plans:

a. Snow and Ice Control Plan;

b. Incident Response Plan; and

c. Courtesy Patrol Service Plan, which shall provide an overview and establish procedures for the Courtesy Patrol Services as described in Section 10 of this Schedule 11;

9.3 **Snow and Ice Control Plan**

9.3.1 Developer shall submit a Snow and Ice Control Plan as part of the OMP. The Snow and Ice Control Plan and subsequent updates shall address requirements for the operations, management, proposed equipment, maintenance yards, materials, staffing and all other items necessary to meet or exceed the Performance Requirements related to Snow and Ice Control Services. An annual update to the Snow and Ice Control Plan shall be submitted by September 1 of each year for Acceptance by the Department.

9.3.2 The Snow and Ice Control Plan shall outline procedures that will be implemented to maintain the I-70 Mainline free from snow and ice to meet the Performance Requirements including location of maintenance yards, procedures for snow and ice clearance plans to maintain traffic flows during and after a Precipitation Event, procedure for sourcing and analysis of weather information, procedures for meeting response times, procedures for meeting treatment and sweeping requirements to counteract ice and snow accumulation, procedures for techniques to be adopted on all lane types including Tolled Express Lanes and General Purpose Lanes.

9.3.3 The Snow and Ice Control Plan and all updates shall at a minimum contain the following:

a. Management and administration;

b. Safety approach and compliance with O&M Safety Plan;

c. Quality approach and compliance with O&M Quality Management Plan;

d. Description of facilities that will be used for staging, including locations;

e. Approach to monitoring and oversight;

f. Frequency of monitoring patrols during and between Precipitation Events;

g. Weather forecasting systems, processes and procedures;

h. Equipment, number, size and type;

i. Materials and chemicals to be used;

j. Description of Snow Routes;

k. Description of patrol size and philosophy of plowing including shift and shift change times;

l. Call out procedures including personnel, contact lists;

m. Details on how response times will be addressed;

n. Application procedures for liquid and/or solid de-icers and anti-icers;

o. Calibration of Spreaders and liquid de-icer and anti-icer equipment;

p. Staff training plan;

q. Precipitation Event reporting and documentation;

r. Procedure for post- Precipitation Event clean-up work;

s. Procedure for sweeping;

t. Procedure for meeting Denver Regional Council of Government's air quality requirements after Precipitation Events;

u. Procedure for reporting including results with respect to Performance Requirements, and pre- and post- event meetings.

9.4 Incident Response Plan

9.4.1 Developer shall submit an Incident Response Plan ("IRP") as part of the OMP that is consistent, and demonstrates how Developer will comply, with Incident management requirements of relevant Governmental Authorities. In the IRP, Developer shall address as a minimum:

a. description of Developer's specific responses to Incidents;

b. the responsibility to prepare, and turnaround time for the preparation of, monthly Incident reports in electronic format (and as further specified in this Schedule 11) and submission of them to the Department when Incidents occur;

c. all issues associated with Hazardous Substances spills; and

d. necessary coordination responsibilities with the Department and relevant Governmental Authority and Emergency Services personnel when Incidents occur.

10. COURTESY PATROL REQUIREMENTS

10.1 Patrols

10.1.1 For the duration of the O&M Period During Construction and the Operating Period, Developer shall provide Courtesy Patrol Services service for the Project as described in this Section 10 and

in Appendix B of this Schedule 11. The purpose of the service is to reduce congestion and potential safety risks on the Project by:

a. Continuously patrolling within the Project during peak and non-peak traffic hours and weekends;

b. Providing towing and motorist assistance services;

c. Providing towing services for the Tolled Express Lane(s) and General Purpose Lane(s);

d. Providing on-call severe weather emergency or planned Special Event towing services; and

e. Quickly locating, assisting, and/or removing any disabled vehicles thereon as soon as possible.

10.1.2 Categories of Service

a. Developer shall provide five general categories of service, as follows:

i. To locate a disabled vehicle on the shoulder of the highway segment and, at the motorist's election, to move the vehicle to an appropriate drop-site and there to provide the limited assistance available to Developer (i.e. flat tire, out of gas, etc.) if such assistance will make the vehicle operational;

ii. To locate a disabled vehicle in traffic on the highway segment and, at the motorist's election, to move the vehicle either to the shoulder of the highway segment or to an appropriate drop site, and there to provide the limited assistance available to Developer if such assistance will make the vehicle operational;

iii. To assist motorists, and Local Agencies or Emergency Services as requested, concerning an accident or other emergency on the highway segment. Such assistance includes, without limitation, towing or pushing vehicles as directed, protecting the scene of an accident, cleaning up debris caused by an accident, and calling and assisting local law enforcement in the event of an accident;

iv. To pick up light debris on roadway; and

v. Data collection communication to the Department.

11. SNOW AND ICE CONTROL SERVICES

11.1 Developer shall provide Snow and Ice Control Services commencing from (and excluding) the date of issuance of NTP3 for the remainder of the O&M Period During Construction and the Operating Period in accordance with the requirements in this Schedule 11, including Appendix A-1 and A-2.

11.2 Developer shall achieve a Level of Service 'A' with respect to all snow and ice control "survey items" as identified in CDOT's Maintenance Levels of Service Manual, including condition 1 with respect to "snow removal's road condition" requirement in the manual.

11.3 Developer is required to use all available resources to assess weather conditions and make decisions and direct actions that maintain the travel ways as safe as possible during and after the occurrence of any Precipitation Event that causes the roadway or any portion of the Project to accumulate snow and/or ice. Developer shall use all available resources to maintain safety on the travel ways and for ensuring that all Developer staff are aware of the relevant Performance Requirements. The Snow and Ice Control Services include, but are not limited to, loading materials on trucks, snow plowing and the application of salt and liquid de-icers and anti-icers within the O&M Limits.

11.4 Developer shall also be responsible for all clean up following the occurrence of a Precipitation Event including touch up work to remove snow that could cause freeze-thaw or traffic hazards and sweeping as required by the Denver Regional Council of Governments. Developer shall

place necessary Snow and Ice Control Equipment in service and react to changing weather and roadway conditions as quickly as possible; at a minimum to meet the response times specified in Appendix A-1 and A-2.

11.5 Developer shall take all necessary actions to achieve the following.

a. Provide all Snow and Ice Control Services.

b. Provide all resources necessary for the performance of the Snow and Ice Control Services.

c. Minimize delay and inconvenience to Users as a result of the occurrence of any Precipitation Event.

d. Identify and correct all Defects and damage which are caused by any Precipitation Event or Developer causes in the provision of the Snow and Ice Control Services.

e. Monitor and observe weather and weather forecasts to proactively deploy resources to minimize delays and safety hazards due to Precipitation Events.

f. Minimize the risk of damage, disturbance or destruction of third party property during the provision of the Snow and Ice Control Services.

g. Coordinate with the Department and Local Agencies with statutory duties or functions in relation to the Snow and Ice Control Services. Coordination shall include interface, edge areas, and boundaries between Developer, the Department, and the Local Agency to ensure the Site and adjacent vicinity is covered.

h. Provide all necessary post-Precipitation Event sweeping.

i. Provide oversight and inspection to assure that the Snow and Ice Control Services are being conducted in accordance with the provisions of the Snow and Ice Control Plan and in accordance with the O&M Safety Plan.

j. Actively participate in meetings scheduled by the Department to plan for all forecast Precipitation Events and for debriefing after all Precipitation Events.

11.6 Snow and Ice Control Equipment

11.6.1 Developer shall determine, in its discretion and in accordance with Good Industry Practice, the equipment (the "Snow and Ice Control Equipment") including service vehicles, loaders and trucks that it requires to provide the Snow and Ice Control Services. The Snow and Ice Control Equipment shall also include such equipment as is expressly required by this Schedule 11. Each item of Snow and Ice Control Equipment used by Developer in the provision of the Snow and Ice Services shall have the necessary valid registrations, permits, licenses, insurance and certifications. Developer shall maintain each item of Snow and Ice Control Equipment to the minimum standard established by commercial vehicle inspection as enforced by the Colorado State Patrol Motor Carrier Safety Section, which is charged with ensuring the safe operation of all commercial vehicles and operators within the State, and the Federal Motor Carrier Safety Regulations which apply in the State of Colorado.

11.6.2 If any item of Snow and Ice Control Equipment is not in a safe condition, then it shall be removed from the worksite and immediately replaced with an item of Snow and Ice Control Equipment that meets all requirements of this Section 11. Any such item of Snow and Ice Control Equipment shall not be returned to service until the necessary repairs or modifications have been made.

11.6.3 Each item of Snow and Ice Control Equipment used by Developer shall bear the name of Developer and shall be assigned a unique number that is prominently displayed on either side of the Snow and Ice Control Equipment while in use.

11.6.4 Developer shall equip all winter operations spreading equipment with on board electronic Spreader control system designed to control the application of highway de-icing chemicals.

a. The system shall consist of: a programmable microprocessor control console, with light emitting diode (LED), vacuum fluorescent display (VFD), or liquid crystal display (LCD) that are easy to read during both day and night operation. The controller shall display to the Spreader operator, application rate settings, gate setting, spinner speed setting, material selected - both granular and liquid, and shall indicate errors. The system operating mode shall indicate manual or automatic. The system shall include a means to transfer data to an Automated Vehicle Locator (AVL) system The discharge of de-icing material shall be controlled proportional to road speed at the pre-programmed application rates.

b. The Spreader control system shall incorporate a data collection system that records all specified data for each event during an operation. A new event occurs every time that the system power is turned on or off, the application rate is changed, material selection is changed, data is downloaded, the operating mode changes, incorrect gate setting, or insufficient material detected.

c. The data collected per event shall include, Truck Number, Event Start Date, Event Start Time, 24 hour clock (HH:MM), Material Type Solid, Spinner Mode (Single or Dual), Spread Rate (lbs/mi), Total Distance (mi), Spread Distance (mi), Spread Quantity (lbs), Blast Distance (mi), Blast Quantity (lbs), Event Type, Material Type Liquid, Pre-wet Liquid Rate (%) and Pre-wet Volume (gal).

d. The system shall have sufficient memory to store a minimum of 100 events per category before downloading is required.

11.6.5 Developer shall equip all winter operations spreading, plowing and anti- icing equipment including patrol vehicles with digital infrared temperature indicating system for both road surface and ambient temperatures, suitable for vehicle mounting and operation. The sensor shall accurately sense road surface and ambient temperatures in all weather conditions and will be capable of taking samples at a minimum of 10 times/second, while the vehicle is not moving or in full motion, to provide “real time” temperature readings. The system accuracy will be +/-1.0^{o}F@32^{o}F, in all operating ambient temperatures from -40^{o}F to 150^{o}F.

11.7 Snow and Ice Removal Restrictions

Snow and Ice Control Services performed in any lanes closed to traffic and behind all temporary barriers shall be done in a way to avoid placing snow back into open lanes of traffic. Snow shall be removed far enough from the edge of travel lanes that runoff from melting snow will not enter into the travel lanes. Developer shall not create windrows or snow piles that may block ramps, intersections or adjoining Local Agency Roadways nor shall Developer leave any windrow or snow piles that may become hazards after a Precipitation Event. Developer shall not cast snow onto the General Purposes Lanes from the Tolled Express Lanes or onto any roads beneath bridges when snowplowing or working on bridges or overpasses. Developer shall not cast snow onto private property, nor cast snow in a way that would cause damage to that property. Notwithstanding other reporting or monitoring requirements identified in this Schedule 11, Developer shall additionally be required to self-report using forms that contain at least the minimum information required by Appendix C to this Schedule 11.

11.8 De-icing and Anti-icing Chemicals

All de-icing and anti-icing chemical materials introduced into the Environment by Developer shall meet or exceed Pacific Northwest Snow Fighters (PNS) criteria, and materials used shall be materials identified on the PNS approved products list, which such materials shall not have any known adverse reactions when used with CDOT anti-icing and de-icing materials. All de-icing and anti-icing chemical materials introduced into the Environment by the Developer shall also conform to the requirements of the Colorado Department of Public Health and Environment, Air Quality Control Commission’s Regulation 16.

12. AUTOMATED VEHICLE LOCATOR

12.1 Developer shall be install and maintain an automated vehicle locator (AVL) system for all motorized equipment used on the Project, including winter operations equipment that is used to perform O&M Work as well as sub-contracted equipment working on the Project for periods of more than two weeks. Notwithstanding the foregoing, all sub-contracted equipment providing electrical, mechanical and plumbing maintenance shall be equipped with AVL. AVL is not required on equipment used for Renewal Work. The system shall track, store, display (on a state highway base map) and report movements and actions, in real-time, with instant live replay every 10 to 12 seconds while in use, 24 hours a day, seven days a week. The system shall transmit data even when the vehicle is turned off. The on-board AVL/GPS unit shall allow for data to be stored when there is no wireless network present, and then uploaded once network service is re-gained. The on-board unit's software shall continuously run tests to determine whether or not network coverage exists prior to transmitting data, to ensure there will be no data loss. If a loss of coverage is detected, the unit shall immediately begin to store the data within the on-board memory allocated to this application. The system shall be capable to read and transmit all data captured by the electronic Spreader control units in all Spreaders, Tow Plow Spreaders and/or plow Spreader combination units and digital infrared temperature indicating system.

13. REPORTING AND LIAISON

13.1 Monthly Operations and Maintenance Reporting Requirements

13.1.1 Developer shall report on all of the monthly O&M Work activities performed during the previous month and the planned activities for the upcoming month ("Monthly O&M Report"), commencing the month following the month in which NTP2 is issued. Monthly O&M Reports shall be submitted to the Department for Acceptance on the 15th of each Month.

13.1.2 The Monthly O&M Reports shall contain at minimum the following information with respect to maintenance activities:

a. A summary of planned O&M Work activities for the upcoming month;

b. A summary of the O&M Work performed and completed for the previous month;

c. A summary of the planned maintenance that was not completed for the previous month, including the reasons for the non-completion and a summary of deferred days for each deferred item;

d. Summary of the maintenance activities and results performed for the previous month beyond the planned maintenance activities for that month;

e. Developer's Incident response logs related to maintenance activities, including a time-based report of all actions and activities performed by Developer including a description of any damages including the date, infrastructure component, details of the resulting Category 1 Defect or Category 2 Defect or damage;

f. Detailed results of all inspections, assessments and testing activities, including the related procedures and forms; and

g. Preventative maintenance plan and progress;

13.1.3 The Monthly O&M Reports shall contain at minimum the following information with respect to operations activities:

a. Monthly Incident reports: For any Incidents that result in damage to any Elements or require response of Emergency Services. The report shall be created identifying the nature of the Incident, time, date, location, parties involved, and actions taken. For Incidents involving fatalities, Developer shall submit the Incident report to the Department within 24 hours of the Incident;

b. Reports on Defects: For each Defect in the Elements, the report shall identify the location, nature, and cause of the Defect and the steps that will be, or have been, taken to address the Defect;

c. Traffic Reports: Each traffic report shall summarize traffic volumes along the Tolled Express Lanes, and the General Purpose Lanes, and associated ramps on a daily, weekly, and monthly basis including hourly information;

d. Summary of conformance with OMQMP;

e. Environmental monitoring activities;

f. Snow and Ice Control Services performed; and

g. Courtesy Patrol Services activities;

13.1.4 Developer shall report on other data that are tracked in the MMIS, or other relevant information, as may be reasonably requested by the Department.

13.2 **Annual Operations and Maintenance Reporting**

13.2.1 The annual report ("Annual O&M Report") shall be submitted 30 Calendar Days after the end of each Contract Year to the Department for Acceptance, and shall contain at minimum the following information:

a. An overall summary of the Tolled Express Lane and General Purpose Lanes traffic and performance for the year including quality, safety, environmental aspects;

b. A summary of the planned maintenance and operations activities for the upcoming year;

c. A summary of the maintenance and operations activities performed and completed for the year along with the results.

d. A summary of the Renewal Work that was performed, including the type of work performed and the dates of commencement and completion of the work. As-Built drawings associated with Renewal Work shall also be provided;

e. A summary of the planned activities that were not completed for the year, including the reasons for the incompletion and a summary of deferred days for each deferred item;

f. Summary of the maintenance and operations activities performed for the year beyond the planned activities for that year;

g. Summary of Noncompliance Points accrued including details of each Noncompliance Event;

h. Summary of Non-Permitted Closures including details of each Non-Permitted Closure;

i. Developer's Incident response logs including a time-based report of all actions and activities performed by Developer;

j. Results of all inspections, assessments and testing activities;

k. Preventative maintenance plans and progress; and

l. Other data that are tracked in the MMIS and other information as may be reasonably requested by the Department.

13.3 **Project Meetings**

13.3.1 Developer shall schedule, prepare an agenda, and facilitate monthly meetings, or as needed, with the Department representatives to discuss the O&M Work and to review O&M Work status including the reports required in this Schedule 11. The items to be discussed shall include, but not be limited to: O&M Work in the previous month, planned O&M Work for the following month, public information and User issues, future Closures, Incidents and Emergencies, Incident management coordination, accrual of Noncompliance Points, Construction Closure Deductions

and Operating Period Closure Deductions, and any other pertinent information related to the O&M Work. The Department may wish to hold separate meetings for general management/operations and maintenance as required.

13.3.2 The Department may request a meeting at any time to discuss O&M Work-related issues and accidents. In addition, Developer shall coordinate meetings to be held at least one week prior to planned Closures. Developer shall be required to actively participate in toll system meetings, major work meetings, meetings to plan for all forecast Precipitation Events and for debriefings after all Precipitation Events, planning meetings and others as directed by the Department, and shall provide assistance, information, and expertise as needed.

13.3.3 Developer shall conduct Incident debriefings to review lessons learned and best practices. These Incident debriefings shall be summarized at subsequent meetings. Developer shall be required to attend quarterly meetings with the Department to review any safety and traffic operations issues or requests related to the O&M Work of any Elements.

13.4 Project Liaison

13.4.1 Developer shall liaise with the Department and other Governmental Authorities, companies including Utilities and adjoining jurisdictions to ensure that planned maintenance and other proposed Closures do not conflict with closures on adjacent facilities or Governmental Approvals or Permits granted for right of access or special hauling.

13.4.2 Developer shall liaise with the Department to keep informed of Governmental Approvals or Permits granted for the Project.

13.4.3 Developer shall provide the Department with one point-of-contact, Developer's Representative, as a member of Developer's Key Personnel with authority to coordinate all O&M Work. The Department will require contact details for the primary, secondary and back-up contacts that are knowledgeable with the O&M Work and have decision making authority.

13.5 Annual Review of O&M Work

13.5.1 The Department will meet with Developer to discuss any potential impacts to the O&M Work, including those that may result from the occurrences below as well as any changes which may be required to the MMP and OMP:

a. A change to statewide maintenance programs or practices;

b. A change to any of the policies, procedures, standards, manuals, handbooks, guides, specifications, or any other State, local, or federal documents used to monitor the performance of the O&M Work;

c. Increased maintenance due to the construction of roadways, structures, and facilities not included in the Department's work program at the time of execution of this Agreement;

d. Increased maintenance due to the transfer of ownership to the Department of non-state roadways, structures, and facilities within the O&M Limits; and

e. Additional requirements as a result of traffic operational improvements.

14. DELIVERABLES

14.1 Deliverable Requirements

At a minimum, Developer shall submit the following to the Department for Information, Acceptance, and/or Approval in accordance with the timeframes specified.

Deliverable	Information, Acceptance, Approval	Schedule

Deliverable	Information, Acceptance, Approval	Schedule
O&M Limits During Construction Drawings; and subsequent updates	Approval	Prior to NTP2; Updated as required
Baseline Asset Condition Inspection Plan	Acceptance	Prior to NTP2
Baseline Asset Condition Report	Acceptance	Prior to NTP2
O&M Limits After Construction Drawings	Approval	Prior to Substantial Completion
MS4 permit annual reporting	Acceptance	December 31 of each Calendar Year
Updates to Performance and Measurement Table in Appendix A-2	Approval	90 Calendar Days before the anticipated Substantial Completion Date; no later than 60 Calendar Days before the end of each Contract Year
Maintenance Management Plan (MMP), including Plans forming the MMP	Acceptance	Prior to NTP2, and updated version prior to Substantial Completion; 60 Calendar Days before the end of each Contract Year; or more frequently as required.
Operations Management Plan (OMP), including Plans forming the OMP	Acceptance	Prior to NTP2, and updated version prior to Substantial Completion; 60 Calendar Days before the end of each Calendar Year; or more frequently as required.
Snow and Ice Control Plan	Acceptance	Same schedule as the OMP; and annual updates by September 1 of each year
Monthly O&M Report	Acceptance	15th of each month commencing the month following NTP2
Annual O&M Report	Acceptance	30 Calendar Days after the end of each Contract Year
Maintenance Management Information System (MMIS) Operating Manual, and demonstrated functionality	Acceptance	Prior to NTP2
Updates to Useful Life Baseline Requirements Table	Approval	90 Calendar Days before the anticipated Substantial Completion Date; and no later than 60 Calendar Days before the end of each Contract Year thereafter
Annual Renewal Work Schedule	Acceptance	Not later than 60 Calendar Days before the end of each Contract Year

Deliverable	Information, Acceptance, Approval	Schedule
Five Year Renewal Work Schedule	Acceptance	Not later than 60 Calendar Days before the end of each Contract Year

15. APPENDICES

Appendix A-1 Performance and Measurement Criteria During Construction

Appendix A-2 Performance and Measurement Criteria After Construction

Appendix B Courtesy Patrol Requirements

Appendix C I-70 East Snow Removal Survey

Appendix A-1 – Performance and Measurement Criteria During Construction

Note. Unless stated otherwise, Measurement Criteria for pavement related Performance Requirements shall be measured using procedures, techniques, and the measuring equipment used shall be consistent with the Colorado DOT Distress Manual for HMA and PCC Pavements by National Center for Pavement Preservation, Appendix B of the Development of a Pavement Preventative Maintenance Program for the Colorado Department of Transportation, Report No. CDOT-DTD-R- 2004-17 Final Report.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
1	**PAVEMENT (ROADWAY, RAMPS, ACCESS ROADS AND OTHER PAVED AREAS)**						
1.1	I-70 Mainline, and Local Agency Roadways and connecting structures.	Elements to be free from obstructions and debris.	2 hrs	N/A	N/A	Visual Inspection	No Obstructions or debris noted by visual inspection.
1.2	Pavement - All roadways, including ramps, detours, and shoulders (mainline including the bridge deck, covers, gratings, frames, expansion joints and boxes)	Smooth and quiet surface course with adequate skid resistance and free from Defects.	2 hrs	48 hrs	12 mo.	**a) Localized deficiencies -** Physical measurement.	Maintain or exceed condition as identified in the BACR.
						b) Faulting	Maintain or exceed condition as identified in the BACR.
						c) Lane to lane, and lane to shoulder drop-off - Physical measurement	No instances of drop-off greater than 1.0 inch.
						d) Visual Inspection of roadway surfacing	No instances of failure, including potholes, greater than 1.0 ft 2 and 1.5 inch in depth. No instances of base failures, punch-out's and jointed concrete pavement failures.
						e) Edge drop-offs Physical measurement of edge drop-off level to adjacent surface	Maintained roadway (including shoulder) free from instances greater than 2".

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
1.2 (cont.)						**d) Instances of pavement failures-** Visual Inspection of roadway surfacing	No instances of failure including potholes, base failures, punchouts and jointed concrete pavement failures.
1.3	Pavement - All roadways, including ramps, detours, and shoulders (mainline including the bridge deck, covers, gratings, frames, expansion joints and boxes)	Removal of deleterious material and repair of damaged pavement	12 hrs	28 days	N/A.	Oil, antifreeze, gasoline or other liquids spilled from vehicles onto traffic lanes is removed from the roadway.	Incident logs and maintenance records demonstrate scheduled inspections and clean up times.
1.4	Crossovers, access roads and other paved areas	Elements are free of Defects.	12 hrs	28 days	12 mo.	Measurement of potholes and base failures.	No instances of potholes or base failures.
1.5	Curbs	Maintain or exceed the condition as identified in the BACR.	7 days	28 days	N/A	Visual inspection	Maintain or exceed condition as identified in the BACR.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
2.	**DRAINAGE SYSTEMS**						
2.1	Storm Sewer Systems (conduit, catch basins, inlets, manholes, outfalls), including adjacent drainage conduit extending from an existing drainage structure to the next downstream existing drainage structure.	Each element of the drainage system is maintained to ensure it functions correctly from the point at which water drains to the outfall or drainage way.	2 hr	28 days	N/A	Compliance with the CDOT Level of Service Manual (Drainage Inlets and Structures). Measurement of clogging of pipes, conduits, catch basins, inlets, or outfalls.	No instance of a condition rating for any inspected ratable item rated as “C” or worse.
2.2	Open Water Carriers (standard roadside ditches, median ditches, relocated channels, channel linings)	Each Element of the drainage system is maintained to ensure it functions correctly.	24 hrs	28 days	N/A.	Visual inspection and all elements rated in accordance with the CDOT Level of Service Manual (Drainage Ditches).	No instance of a condition rating for any inspected ratable item rated as “C” or worse. No instances of: Undermining, undercutting, erosion, or obstructions impeding the flow of water

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
2.3	Pavement Drainage (trench drains, slotted drains, gutters, catch basins, inlets, outlets)	Each element of the drainage system is maintained to ensure that it functions correctly.	2 hrs	28 days	N/A	Measurement of standing water within the I-70 Mainline and on paved surfaces.	Maintain or exceed condition as identified in the BACR.
2.4	Culverts	Culvert is maintained and functions correctly, joints remain soil tight and erosion controlled.	2 hrs	28 days	N/A.	Culvert condition and functionality.	Culvert functioning as designed.
2.5	End Treatments (Headwalls, precast reinforced concrete outlets, concrete apron)	Elements are maintained and function correctly.	24 hours	28 days	N/A	Visual inspection of erosion, undercutting, scour, cracked, spalled, or broken concrete.	Maintain or exceed condition as identified in the BACR.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
2.6	Storm water systems	Storm water systems installed as permanent features maintained, functioning correctly, and operating as designed.	24 hrs	28 days	N/A	Compliance with regulations and standards and in accordance with CDOT's Erosion Control and Storm Water Quality Guide (ECSQG). **Manufactured Systems:** Compliance with manufacturers manuals **Vegetated Biofilters/Filter Strips:** Inspection of slopes and ditch bottom; vegetation management; debris and litter management. **Detention Ponds:** Inspected and checked for compliance with management plan. **Bioretention Cell, Infiltration:** Inspected for excessive ponding; overgrown vegetation, litter/debris; erosion and deposition; and outlet structure clogging **Infiltration Basin/Trenches:** Inspected for debris, overgrown vegetation, level of sedimentation; and condition of observation wells; **Constructed Wetlands:** Effectiveness of vegetation management; absence of erosion, clogging; litter/debris and sediment.	Operate as designed and no instances of non-compliance with regulations and standards and ECSQG. Operate as designed and routine clean-out, removed material sampled and tested in line with manufacturers manuals Filters performing as designed. All systems operate as designed and no instances of excessive ponding, threats to structural soundness of embankments and outlet structures; excessive erosion and sediment, seepage from embankments, overgrown vegetation, outlet clogging or litter/debris.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
2.7	Discharge systems	Surface water discharge systems perform their proper function and discharge to groundwater and waterways complies with the relevant regulations and permits.	24 hrs	28 days	N/A	Compliance with regulations and in accordance with CDOT's Erosion Control and Storm Water Quality Guide.	No instances of non-compliance.
3.	**STRUCTURES**						
3.1	Structures having an opening measured along the center of the roadway of more than 20 feet between under copings of abutments or springlines of arches or extreme ends of openings or multiple boxes.	Substructures and superstructures are free of: • graffiti • undesirable vegetation • debris and bird droppings • blocked drains, weep pipes manholes and chambers • blocked drainage holes in structural components • defects in joint sealants • defects in pedestrian protection measure • scour damage • corrosion of rebar • paint system failures • impact damage Bridge structures maintain a minimum vertical clearance of 16.5 feet over traveled lanes. Maintain structures to specified condition rating.	24hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Condition Evaluation of Bridges, and the FHWA Bridge Inspector Reference Manual.	Records as required in the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Bridge Evaluation. No occurrence of NBI condition rating below seven for any new deck, superstructure or substructure. No occurrence of NBI condition rating below six for any widened or rehabilitated deck, superstructure or substructure, prior to reconstruction of a new structure. All Pontis condition states to be one or two for all structure components.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.2	Structure component	i) Expansion joints are free of: • dirt debris and vegetation • defects in drainage systems • loose nuts and bolts • defects in gaskets • leaking ii) The deck drainage system is free of all and operates as intended. iii) Barriers are free of: • loose nuts or bolts • blockages of hollow section drain holes • graffiti • vegetation • accident damage iv) Bearings and bearing shelves are clean.	24 hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Condition Evaluation of Bridges, and the FHWA Bridge Inspector Reference Manual.	Records as required in the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Bridge Evaluation. No occurrences of NBI condition rating below seven for any new deck, superstructure or substructure No occurrence of NBI condition rating below six for any widened or rehabilitated deck, superstructure or substructure, prior to reconstruction of a new structure. All Pontis condition states to be one or two for all structure components.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.2 (cont.)	Structure component (continued)	v) Sliding and roller surfaces are clean and greased to ensure satisfactory performance. Additional advice contained in bearing manufacturers' instructions, in the Current CDOT M&S Standard Plans, Standard Specification for Road and Bridge Construction is followed. Special finishes are clean and perform to the appropriate standards. vi) All non-structural items such as hoists and electrical fixings, operate correctly, are clean and lubricated as appropriate, in accordance with the manufacturer's recommendations and certification of lifting devices are maintained. vii) Maintain structures to specified condition rating.					

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.3	Structures (general) – including existing viaduct.	Safe operation of structures, maintained to prevent safety issues arising	1 hrs	28 days	12 months	Inspection of surfaces adjacent to and above the Roadway, and all structural components.	No instances of delaminated concrete above the Roadway. Maintain or exceed condition as identified in the BACR.
3.4	Non-bridge class culverts	Non-bridge-class culverts are free of: • vegetation and debris and silt • defects in sealant to movement joints • scour damage	24hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Condition Evaluation of Bridges, and the FHWA Bridge Inspector Reference Manual.	Records as required in the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Bridge Evaluation. No occurrences of NBI condition rating below seven for any culvert elements. All Pontis condition states to be one or two for all structure components. Vegetation, debris and silt levels to be at or lower than that identified in the BACR. None with defects in sealant and movement joints. None with scour damage.
3.5	Retaining walls	Maintain retaining walls free of vertical, lateral or rotational movement with no material defects compromising the intended performance.	24hrs	28 days	6 months	Physical Measurement and Inspections.	Maintain or exceed condition as identified in the BACR.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.6	Sign structures	Sign gantries are structurally sound and free of: loose nuts and bolts, defects in surface protection systems, graffiti	24hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of CDOT Signs and Signals Coding Guide.	All condition states to be one or two for all structural members. None with loose assemblies. None with defects in surface protection. None with graffiti
3.7	Load ratings	All structures maintain the design load capacity	24hrs	28 days	6 months	Load rating calculations in accordance with the AASHTO Manual for Bridge Evaluation the current version of the CDOT Pontis Bridge Inspection Coding, and CDOT Bridge Rating Manual. Load restriction requirements as per AASHTO Manual for Bridge Evaluation, the current version of the CDOT Pontis Bridge Inspection Coding, and CDOT Bridge Rating Manual.	Comply with load restrictions on new structures for Colorado legal loads (including legally permitted vehicles)

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat. 2 Permanent Repair	MEASUREMENT CRITERIA*	TARGET*
4	**ROADWAY MARKING**						
4.1	Pavement markings – General	Pavement markings are: • clean and visible during the day and at night • whole and complete and of the correct color, type, width and length • correctly placed to meet the MUTCD and the Colorado Supplement to MUTCD, as well as the CDOT M&S Standard Plans.	24 hrs	28 days	6 mo.	Compliance with regulations Minimum Average Retro-reflectivity (mcd/m2/lux) measured using a retro-reflectometer having 30-meter geometry - average of 10 readings at approximately 1/10 mile increments or 10 equal increments per ramp less than 1 mile long for long lines: - average of 5 readings for each auxiliary marking Measured minimum presence on the Pavement Surface, including bridge decks Measured pavement markings color Luminance Factor (Cap Y) requirements as prescribed in ASTM 6628	100% in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and the MUTCD -Colorado Supplement Long Lines – White 200 Long Lines – Yellow 125 Auxiliary Markings – White 200 Auxiliary Markings - Yellow 125 Long Lines 90% per 528 ft (1/10th mile) Auxiliary Markings 75% White > 35, Yellow > 25

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
4.2	Reflective markers	Reflective pavement markers (RPM's), are: • clean and clearly visible • of the correct color and type • reflective or retroreflective as required in the MUTCD and Colorado Supplement • correctly located, aligned and at the correct level • are firmly fixed • are in a condition that will ensure that they remain at the correct level.	24 hrs	28 days	6 mo.	Number of pavement markers in any 10 consecutive markers that are ineffective. (Ineffective includes missing, nonreflective, broken, damaged, settled or sunk) Number of pavement marker casting securely fastened (Category 1 defect) Uniformity; percentage (replacement RPM's having equivalent physical and performance characteristics to adjacent markers.)	Maintain or exceed condition as identified in the BACR.
4.3	Delineators & Markers	Object markers and delineators are: • clean and visible • of the correct color and type • legible and reflective • straight and vertical	2 hrs	48hrs	28 days	Number of object markers or delineators defective or missing	Maintain or exceed condition as identified in the BACR.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
5	**GUARD RAILS, BARRIERS, IMPACT ATTENUATORS**						
5.1	Guard rails and traffic barriers	All guardrails, traffic barriers and other concrete barriers are maintained free of Defects. They are appropriately placed and correctly installed at the correct height and distance from roadway or obstacles.	2 hrs	48 hrs	1 mo.	Length free from Defects (loose nuts/bolts) Surface condition Guardrail installed and maintained at correct height and distance from roadway and obstacle in accordance with relevant standards. Posts Spacer Blocks	All nuts, bolts and connections to be properly tightened 90% of surfaces to be free from Defects (spalling of concrete, failure of corrosion protection) within a 12.5 foot section. No Defect greater than 1 foot square or 1 cubic foot of missing material within a 12.5 foot section. 100% within 3 inches vertical of correct system height. Vegetation maintained at least 5 feet behind guardrail. No missing posts. No post shall have section loss greater than 25%, No two adjacent post shall have a combined section loss greater than 25%. No missing spacer or rotated blocks. No section loss greater than 10%.
5.2	Impact attenuators, anchor assembly, and end assembly	All impact attenuators, anchor assemblies, and end assemblies are appropriately placed and correctly installed and maintained free of damage	2 hrs	48 hrs	1 mo.	Percentage of impact attenuators, anchor assemblies, and end assemblies correctly placed and installed and free of damage Integrity of the system	100% 100% cell replacement (unit replacement) following impact.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
6	**SIGNS**						
6.1	General– all sign panels	Signs are clean, correctly located, clearly visible, legible, reflective, at the correct height and free from structural and electrical Defects. Identification markers are provided, correctly located, visible, clean and legible. Sign mounting posts are vertical, structurally sound and rust free. Visibility distances meet those stated in the MUTCD and the Colorado Supplement. Sign information is of the correct size, location, type and wording to meet its intended purpose.	24 hrs	28 days	6 mo.	Compliance with regulations Retroreflectivity in accordance with the requirements of MUTCD and the Colorado Supplement Face Damage Placement Sign information is of the correct size, location, type and wording to meet its intended purpose and requirements of MUTCD and the Colorado Supplement.	No missing signs and 100% in accordance with the current edition of the (MUTCD) and the Colorado Supplement Retroreflectivity is no less than that required by MUTCD and the Colorado Supplement for retroreflectivity. No signs with face damage greater than 10% of area or 0% if text is damaged Signs are placed in accordance with Requirements of the MUTCD and the Colorado Supplement 100%

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
6.2	Safety critical signs	Requirements as 6.1, Plus: "Stop," "Yield," "Do Not Enter," "One Way" and "Wrong Way" and all Turn-Prohibition signs are clean, legible and undamaged.	1 hrs	12 hrs	7 days	Safety critical signs functionally legible when viewed from a vehicle travelling at posted speed Sign mounting posts and multi-Post breakaway working as intended.	No instances of signs functionally illegible (no twisting or leaning). No section loss greater than 10%. Post shall be plum. All connections shall be free from defects.
6.3	Obsolete, illegal or obscene signs, banners, flags, or posters	Removed from the Project	2hr*	48 hrs	N/A	Time for obsolete, illegal or obscene(*) signs to be removed	100% compliance

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
7	**Traffic Signals**						
7.1	Traffic Signals - General	i) Traffic Signals and their associated equipment are: • clean and visible, correctly aligned and operational • free from damage caused by accident or vandalism • correctly aligned and operational ii) Signal timing and operation is correct. iii) Contingency plans are in place to rectify Category 1 Defects not immediately repairable to assure alternative traffic control is provided during a period of failure.	1 hrs	24 hrs	6 mo.	Review of Maintenance records **a) General condition** Visual inspection **b) Damage** Visual inspection **c) Signal timing** Timed measurements **d) Contingency plans** Records Review	Maintained in accordance with Good Industry Practice Signals are clean and visible 100% of the time Signals are undamaged 100% of the time Installations have correct signal timings 100% of the time Full contingency plans are in place 100% of the time.
7.2	Traffic Signals - Electrical Supply	Electricity supply, feeder panels, cabinets, switches and fittings are electrically, mechanically and structurally sound and functioning	1 hrs	24 hrs	6 mo.	Availability of supply of power and electricity to the road lighting system.	A continuous availability level of 100% from metered source to all O&M equipment and facilities.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
7.3	Traffic Signals Soundness	Traffic signals are structurally and electrically sound	24 hrs	28 days	6 mo.	a) Structural soundness Visual inspection b) Electrical soundness Testing to meet NEC regulations	Maintain or exceed condition as identified in the BACR.
7.4	Traffic Signals - Identification marking	Signals have identification markers and the telephone number of the Developer for reporting faults are correctly located, clearly visible, clean and legible	24 hrs	7 days	N/A	Visual inspection and/or notification	Inspection records showing identification markers and other information are easily readable on 100% of markings.
7.5	Traffic Signals - Pedestrian Elements and Vehicle Detectors	All pedestrian elements and vehicle detectors are correctly positioned and fully functional at all times	1 hr	24 hrs	6 mo.	Visual inspection and/or notification	Inspection records showing safe installation and maintenance.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
8	**Lighting**						
8.1	Roadway Lighting – General	i. All lighting is free from defects and provides acceptable uniform lighting quality. ii. Lanterns are clean and correctly positioned. ii. Lighting units are free from accidental damage or vandalism. v. Columns are upright, correctly founded, visually acceptable and structurally sound.	12 hrs	14 days	N/A	Roadway lighting operable - Night time inspection or automated logs Roadway Lighting out of service - Night time inspection or automated logs Visual inspection and/or notification Visual inspection and/or notification	No sections with less than 90% of lights functioning correctly at all times. No Instances of more than two consecutive lights not working. No damage Columns are plumb, bases are not damaged and no section loss.
8.2	Sign Lighting	Sign lighting is fully operational	12 hrs	14 days	N/A	Night time inspection, automated logs or notification	No Instances of more than one bulb per sign not working.
8.3	Lighting - Electrical Supply	Electricity supply, feeder pillars, cabinets, switches and fittings are electrically, mechanically and structurally sound and functioning.	1hr	7 days	1 mo.	Testing to meet NEC regulations, visual inspection	Inspection records showing safe installation and maintenance 100% of the time.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
8.4	Lighting - Access Panels	All access panels in place at all times.	24 hrs	24 hrs	N/A	Visual Inspection or notification	No Instances of missing access panels
8.5	Lighting - Structures	Structurally sound and free of loose nuts and bolts. No defects in surface protection systems. No graffiti.	24 hrs	28 days	6 mo.	Inspection and assessment in accordance with the requirements of CDOT Signs and Signals Coding Guide.	All condition states to be one or two for all structural members. No loose assemblies. No defects in surface protection. None with graffiti.
8.6	Lighting – Fixtures	i. All luminaries functioning on each pole. ii. All obstruction lights are present and working (if required). iii. Compartment door is secure with all bolts in place.	24 hrs	48 hrs	1 mo.	Yearly inspections and night time inspections or automated logs	No instances of two or more lamps not working per high mast pole. No identification of other defects.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
8.6 (Cont.)	Lighting – Fixtures	iv. All non-structural items such as hoists and electrical fixings, operate correctly, are clean and lubricated as appropriate, in accordance with the manufacturer's recommendations and certification of lifting devices are maintained.	24 hrs	48 hrs	1 mo.	Yearly inspections and night time inspections or automated logs	No instances of two or more lamps not working per high mast pole. No identification of other defects.
9	**FENCES AND WALLS**						
9.1	Fences and Walls - Design and Location	Fences and walls act as designed and serve the purpose for which they were intended	1 hr	28 days	6 mo.	Visual Inspection	Maintain or exceed condition as identified in the BACR.
9.2	Fences and Walls - Construction (includes existing)	Integrity and structural condition of the fence is maintained	1 hr	28 days	6 mo.	Structural assessment if visual inspection warrants.	Maintain or exceed condition as identified in the BACR, and ensuring there are no structural safety issues.
10	**ROADSIDE**						

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
10.1	Vegetated Areas - Except landscaped areas - General	Vegetation is maintained so that: i. Height of grass and weeds is kept within the limits described for urban and rural areas. Mowing begins before vegetation reaches the maximum height. ii. Spot mowing at intersections, ramps or other areas maintains visibility of appurtenances and sight distance. iii. Grass or vegetation does not encroach into or on paved shoulders, main lanes, sidewalks, islands, riprap, traffic barrier or curbs. iv. A herbicide program is undertaken to control noxious weeds in accordance with the EO D 006 99.	48 hrs	14 days	28 days	**Urban areas** Physical measurement of height of grass and weeds **Encroachment** Visual inspection of instances of encroachment of vegetation **Wildflowers** Visual Inspection with audit of process. **Sight lines** Visual inspection	Individual measurement areas to have 80% of height of grass and weeds between 5 in. and 18 in. Occurrences of vegetation encroachment shall not exceed the condition identified in the BACR. Maintain or exceed the condition identified in the BACR. No instances of impairment of sight lines or sight distance to signs, including control of weeds in pavement and barrier.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
		v. Development and implementation of noxious weed management program to control noxious weeds and to eliminate grass in pavement or concrete.				**Noxious weeds** Visual inspection and/or notification	Not more than 15% (aggregate) of a 1 mile section of roadway contains noxious weeds. Not more than 15% (aggregate) of a 1/10 mile section of ramp contains noxious weeds.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
10.2	Landscaped Areas	i. All landscaped areas are maintained to their originally constructed condition. Landscaped areas are as designated in the plans. ii. Mowing, litter pickup, irrigation system maintenance and operation, plant maintenance, pruning, insect, disease and pest control, fertilization, mulching, bed maintenance, watering is undertaken as per MMP. iii. The height of grass and weeds is kept between 6“ and 8”. Mowing begins before vegetation reaches a hazardous condition, such as sight distance, blocking reflectors, hiding animals or causing drifting snow.	48 hrs	14 days	28 days	Visual inspection Roadside appearance is excellent, characterized by well-tended landscaping and vegetation.	The percent of landscaping area meeting the General Requirement is 85%.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
10.2 (cont.)	Landscaped Areas	iv. Damaged or dead vegetation is replaced.					
10.3	Fire hazards	Fire hazards are controlled	24 hrs	28 days	N/A	Instances of dry brush or vegetation forming a fire hazard are removed.	No instances of plant material that is a fire hazard.
10.4	Trees, brush and ornamentals	i) Trees, brush and ornamentals on the right of way, except in established no mow areas, are trimmed in accordance with CDOT standards. ii) Trees, brush and ornamentals are trimmed to insure they do not interfere with vehicles or sight distance, or inhibit the visibility of signs or shading on the road. iii) Dead trees, brush, ornamentals and branches are removed. Potentially dangerous trees or limbs are removed. iv) All undesirable and unplanned trees and	24 hrs	7 days	28 days	Visual inspection and/or notification	Maintain or exceed the condition identified in the BACR.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
		vegetation are removed. Diseased trees or limbs are treated or removed by licensed personnel.					
10.5	Wetlands	Wetlands are properly managed, and in accordance with any applicable permit requirements.	48 hrs	28 days	N/A	In accordance with applicable permit requirements	Maintain or exceed the condition identified in the BACR.
10.6	Water Quality Ponds	Maintenance of all vegetation within the pond area	24 hrs	7 days	28 days	Visual inspection of ponds	Maintained as required per the design
11	**EARTHWORKS & EMBANKMENTS**						
11.1	Slope – Stability	All structural or natural failures of the embankment and cut slopes on the Site are repaired	1 hr	28 days	6 mo.	Visual inspection by geotechnical specialist and further tests as recommended by the specialist	Recorded instances of slope failure
11.2	Slopes - General	Slopes are maintained in general conformance to the original graded cross-sections.	24 hrs	28 days	6 mo.	Areas where replacement of landscaping materials, reseeding and re-vegetation for erosion control purposes and removal and disposal of all eroded materials from the roadway and shoulders are required.	Maintain or exceed the condition identified in the BACR.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
12	**GRAFFITI**						
12.1	Graffiti	Graffiti is removed	24 hrs	10 days	N/A	Removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces. All graffiti is considered a Category 1 Defect.	Inspection records showing 100% compliance
12.2	Offensive Graffiti	Offensive graffiti is removed	1 hr	10 days	N/A	Removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces. All graffiti is considered a Category 1 Defect.	Inspection records showing 100% compliance
13	**INCIDENT RESPONSE**						
13.1	General	Respond to Incidents in accordance with the Incident Response Plan.	1 hr	N/A	N/A	Incident Response Plan. No complaints from Emergency Services.	Response times met for 98% of Incidents measured on a 1 year rolling basis.
13.2	Spillage of Hazardous Materials	For any hazardous materials spills, comply with the requirements of Schedule 17.	1 hr	1 day	N/A	Incident Response Plan details the process and procedures in place and followed.	Inspection records showing compliance.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
13.3	Elements damaged as a result of Incident - Structural Assessment	Evaluate damage to structures and liaise with emergency services to ensure safe working in clearing the Incident.	1 hr	1 day	N/A	Inspections and surveys of relevant Elements as required. (Note. CDOT staff bridge office shall be notified immediately to complete an inspection.)	Inspection records showing 100% compliance
13.4	Elements damaged as a result of Incident - Temporary and permanent remedy	Propose and implement temporary measures or permanent repairs to Defects arising from the Incident. Ensure the structural safety of any structures affected by the Incident.	24 hrs	14 days	6 mo.	Review and inspection of the relevant Elements.	Inspection records showing 100% compliance.
14	**MAINTENANCE YARD**						
14.1	Developer Identification Signs	Signs installed at the entrance(s)/exit(s) to/from the Maintenance Yard.	7 days	30 days	12 mo.	Signs installed depicting the name and contact information for Developer	Signs functioning as designed.
14.2	Environmental contamination	No increase in contamination.	2 hr	48 hr	6 mo.	Environmental site assessment or other inspections, as necessary.	No increase in contamination during the O&M Period During Construction.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
14.3	Maintenance of grounds and buildings	Kept in a neat and tidy order. Kept structurally safe.	24 hr	7 days	6 mo.	Good housekeeping practice used to maintain buildings and land in a well maintained and neat condition, free from environmental damage. Regular inspection performed.	100% compliance
15	**SNOW AND ICE REMOVAL**						
15.1	Response Time, material application vehicle	The manning and loading of material application vehicles for a Precipitation Event	½ hr	N/A	N/A	All spreading vehicles on any route ready to load anti-icing or de-icing materials within ½ hour as measured by winter operation records and AVL system monitoring.	The required maximum time to complete the manning and loading of material application vehicles for an event is 0.5 hours from the time precipitation has started.
15.2	Response Time, plowing vehicle	The manning of a snowplow vehicle for a Precipitation Event	½ hr	N/A	N/A	All snowplow vehicles on any route have left the yard and ready to begin work within ½ hour as measured by winter operation records and AVL system monitoring.	The required maximum time to complete the manning of snowplow vehicles for an event is 0.5 hours from the time precipitation has started to the time the unit has left its yard to begin work.
15.3	Plowing and material application	Continuous plowing and material application	N/A	24 hr	N/A	All units operating as measured by winter operation records and AVL monitoring systems.	Once operations have begun, all units as identified in the Snow and Ice Control Service Plan shall operate continuously on all routes until all required service levels have been achieved.
15.4	Circuit time	Complete one entire route within 1 hour	1 hr	N/A	N/A	AVL systems monitoring and/or winter operation record	Circuit time shall be 1 hour from the time a winter unit begins its plowing and/or material application route until the time it is complete.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
15.5	Snow accumulation	Remove snow accumulation adjacent to median barrier walls	1 hr	N/A	N/A	Measured by visual inspection, winter operation record	Snow adjacent to median barrier walls is removed concurrently with I-70 Mainline snow removal on the traveled lanes.
15.6	All lanes and ramps	Bare and wet pavement during the Precipitation Event	1 hr	N/A	N/A	Visual inspection and AVL system monitoring	Maintain Bare and Wet pavement during the precipitation event.
15.7	Paved shoulders (other than median shoulder)	Bare and wet pavement during the Precipitation Event	8 hr	N/A	N/A	Visual inspection and AVL system monitoring	100% compliance
15.8	Hazards	Address any hazard immediately upon detection or notification	1 hr	N/A	N/A	Visual inspection, AVL system monitoring, or notification	100% compliance
15.9	Isolated slippery conditions	Address isolated slippery conditions.	1 hr	N/A	N/A	Visual inspection, AVL system monitoring, or notification	No isolated slippery sections.
15.10	Winter Snow and Ice Materials storage	Winter snow and Ice materials stored in covered buildings at all times.	**	24 hr	N/A	** Noncompliance is a Category 1 Defect.	No instances of uncovered storage of winter de-icing/anti-icing materials.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
15.11	Reporting requirements	All reporting requirements identified in Schedule 11 are accurate, complete, and timely 100% of the time.	1 day	7 days	1 mo.	Audit records and AVL system monitoring.	100% accuracy.
15.12	Automated Vehicle Locator system	All identified vehicles equipped with on board AVL at all times, as required in Section 12 of this Schedule 11	N/A	24 hrs	1 mo.	Random audit, AVL system monitoring.	95% of all AVL units operational 100% of the time. No loss of data due to network service loss.
15.13	Material Spreader calibration	Spreader controller (including winter liquids) calibration is operational.	N/A	24 hrs	N/A	Random audit, AVL system monitoring	95% units operational 100% of the time
15.14	Winter Drainage	Melting snow and ice causing flooding.	1 hr	6 hrs	N/A	Visual inspection, AVL system monitoring	No flooding on roadway caused by snow and/or ice impeding drainage through or to drains, culverts and ditches.
16. COURTESY PATROL							
16.1	Courtesy Patrol	Provide full number of patrol vehicles each shift	**	1/2hr	N/A	** Noncompliance is a Category 1 Defect. Measured by patrol records.	100% of the time

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
16.2	Courtesy Patrol	Respond to any calls on the General Purpose Lanes or Tolled Express Lanes 30min after being dispatched.	**	1/2hr	N/A	** Noncompliance is a Category 1 Defect Measured by patrol records.	100% of the time
17. SWEEPING AND CLEANING							
17.1	Sweeping	i) Keep all channels, hard shoulders, gore areas, ramps, intersections, islands and frontage roads swept clean. ii) Clear and remove debris from all paved areas other than as required in Section 1.1 of this Appendix A-1. iii) Remove all sweepings without stockpiling in the right of way and dispose of at approved site.	12 hrs	14 days	6 months	Visual Inspection of buildup dirt, ice, rock, debris (from accidents and/or otherwise).	Inspection records showing 100% compliance

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
17.2	Litter	i) Keep the Site in a neat condition, remove litter regularly ii) Pick up large litter items before mowing operations. iii) Dispose of all litter and debris collected at an approved solid waste site.	24 hrs	14 days	6 months	Visual Inspection of pieces of litter.	Inspection records showing 100% compliance

Appendix A-2 – Performance and Measurement Criteria After Construction

Note. Unless stated otherwise, Measurement Criteria for pavement related Performance Requirements shall be measured using procedures, techniques, and the measuring equipment used shall be consistent with the Colorado DOT Distress Manual for HMA and PCC Pavements by National Center for Pavement Preservation, Appendix B of the Development of a Pavement Preventative Maintenance Program for the Colorado Department of Transportation, Report No. CDOT-DTD-R- 2004-17 Final Report.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
1	**PAVEMENT (ROADWAY, RAMPS, ACCESS ROADS AND OTHER PAVED AREAS)**						
1.1	I-70 Mainline, and Local Agency Roadways and connecting structures.	Free from obstructions and debris.	1 hrs	N/A	N/A	Visual Inspection	No Obstructions or debris noted by visual inspection
1.2	Pavement - All roadways, including ramps, detours, and shoulders, (mainline including the bridge deck, covers, gratings, frames, expansion joints and boxes)	Smooth and quiet surface course with adequate skid resistance and free from Defects.	2 hrs	24hrs	12 mo.	**a) Drivability Life(DL)** As determined by CDOT Pavement Management Manual. **b) Ruts** Percentage of wheel path length with ruts greater than 0.40 inches in depth. Depth of rut at any spot location. **c) Ride quality** Measured International Roughness Index (IRI) calculated according to ASTM E-1926 using equipment meeting AASHTO M-328 and operated in accordance with AASHTO R-57 using equipment verified and operators certified according to AASHTO R-56.	DL Moderate (4-10) for 100% of O&M Limits After Construction. 80% of project has ruts less than 0.40 inches. Not greater than 0.55 inches. Throughout 80% of maintained roadway area less than or equal to 95 inches per mile on a contiguous 1/10th mile basis. Throughout 100% of maintained roadway area less than or equal to 160 inches per mile.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
1.2 (cont.)	Pavement - All roadways, including ramps, detours, and shoulders, (mainline including the bridge deck, covers, gratings, frames, expansion joints and boxes)	Smooth and quiet surface course with adequate skid resistance and free from Defects.	2 hrs	24 hrs	12 mo.	Localized roughness measured as mean IRI to ASTM E 1926 using a continuous 25 foot (7.6 m) base length analysis for each wheelpath.	No instance of IRI greater than 300 inches per mile on a 25' continuous base length.
						d) Instances of Pavement Failures Visual Inspection of roadway surface. Specific defects are defined in Publication No.FHWA-RD-03-031, Long-Term Pavement Performance Program's Distress Identification Manual	No instances of failure including potholes, base failures, delamination of pavement layers, blowups, faulting, punchouts. No instances of lane-to-lane or lane-to-shoulder separation or drop-off greater than 0.5 inches. Longitudinal cracking or joint separation <100 feet/tenth lane mile. Transverse cracking <10 each/tenth lane mile. PCCP Specific: • D-Cracking <2 slabs/tenth lane mile. • Corner Breaks<5 each/tenth mile • Scaling<70 sq ft/tenth mile • Spalling<2 sq ft/tenth mile
						e) Edge drop-offs Physical measurement of edge drop-off level to adjacent surface	Maintained roadway (including shoulder) free from instances greater than 2"

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
1.2 (cont.)	Pavement - All roadways, including ramps, detours, and shoulders (mainline including the bridge deck, covers, gratings, frames, expansion joints and boxes)	Skid resistance shall be measured on 2 year cycle for high stress areas (interchanges or tight curves) with testing every 4 years or after a resurfacing for areas that are not high stress.	7 days	28 days	6 mo.	**f) Skid resistance** Skid resistance on high stress areas (interchanges or tight curves) Skid resistance areas that are not high stress. Skid resistance measured in accordance with ASTM E 274 Standard Test Method for Skid Resistance Testing of Paved Surfaces at 40 MPH using a full scale smooth tire meeting the requirements of ASTM E 524.	Instances where skid number is below high stress site: any test values 25 or lower within any 0.5 mile section of mainline, shoulders and ramps. Average test value 25 or lower within any 0.5 mile section of mainline lanes, shoulders and ramps.
		Posting of slippery road signs on sections exceeding skid resistance threshold.	2 hrs	7 days	6 mo.	Signs posted within timescale measured from test date.	100% of the time
		Perform site investigation in accordance with CDOT applicable manuals and implement resultant required corrective action where skid resistance exceeds thresholds.	30 days	90 days	6 mo.	Delivery of site investigation report and implementation of resultant corrective actions within timescale measured from test date.	100% of the time

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
		Removal of deleterious material and repair of damaged pavement	24 hrs	48 hrs	12 mo.	Oil, antifreeze, gasoline or other liquids spilled from vehicles onto traffic lanes is removed from the roadway	Incident logs and maintenance records demonstrate scheduled inspections and clean up times.
		Noise measurement is carried out when problem is suspected or complaints warrant investigation.	N/A	7 Days	12 mo.	Pavement noise as measured by on board sound Intensity in accordance with AASHTO TP 76 (measurements taken on a contiguous 1/10th mile basis)	Mainline and system ramps: < 105db
1.3	Crossovers, access roads and other paved areas	Crossovers, access roads and other paved areas are free of Defects	4 hrs	48 hrs	12 mo.	Measurement of potholes and base failures	No instances of potholes or base failures
2.	**DRAINAGE SYSTEMS**						

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
2.1	Storm Sewer Systems (conduit, catch basins, inlets, manholes, outfalls), including adjacent drainage conduit extending from an existing drainage structure to the next downstream existing drainage structure.	Each element of the drainage system is maintained to ensure it functions correctly from the point at which water drains to the outfall or drainage way,	1hr	28 days	6 mo.	All storm sewers, pipes and conduits, regardless of size or location, inspected and rated in accordance with the CDOT Level of Service Manual (Drainage Inlets and Structures) Measurement of clogging of pipes, conduits, catch basins, inlets, or outfalls. Measurement of discontinuities and settlement between adjacent conduit segments or within conduit segment. Measurement of cracking, spalling in concrete pipes Measurement of joints in drainage system.	No instance of a condition rating for any inspected ratable item rated as “B” or worse. No instances of: • Clogging or blockage of pipes, conduits, catch basins or inlets in pavement or adjacent to pavement, or outfalls greater than 10% of hydraulic capacity. • Clogging or blockage of catch basins or inlets in ditches greater than 25% of hydraulic capacity. No offsets greater than 1.5inches or ponding greater than 3inches No cracks open greater than 1/8”. No spalling or scaling deeper than ¾” or exposed reinforcement. No instances of separated joints or missing joint material or joints not soil tight.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
2.2	Open Water Carriers (standard roadside ditches, median ditches, relocated channels, channel linings)	Each Element of the drainage system is maintained to ensure it functions correctly.	24 hrs	28 days	12 mo.	Visual inspection and all elements rated in accordance with the CDOT Level of Service Manual (Drainage Ditches). Ditches/channel length out of alignment, and damages or missing sections in ditches/channel lining.	No instance of a condition rating for any inspected ratable item rated as “B” or worse. No instances of: Undermining, undercutting, erosion, or obstructions impeding the flow of water No ditches/channel length out of alignment, and no damaged or missing sections in ditches/channel lining.
2.3	Pavement Drainage (trench drains, slotted drains, gutters, catch basins, inlets, outlets)	Each element of the drainage system is maintained to ensure it functions correctly.	1 hrs	28 days	6 mo.	Measurement of standing water within I-70 Mainline, paved shoulder, or other paved surfaces.	No instances of standing water in any Mainline and no greater than 1” in depth elsewhere
2.4	Culverts	Culvert is maintained and functions correctly, joints remain soil tight and erosion controlled.	1 hrs	28 days	6 mo.	Culvert condition and functionality.	Culvert functioning as designed.
2.5	End Treatments (Headwalls, precast reinforced concrete outlets, concrete apron)	Elements are maintained to ensure they function correctly.	24 hours	28 days	6 mo.	Visual inspection of erosion, undercutting, scour, cracked, spalled, or broken concrete.	No instances of undercutting, scour, cracked, spalled, or broken concrete.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
2.6	Storm Water systems	Storm Water Systems installed as permanent features maintained, functioning correctly, and operating as designed.	24 hrs	28 days	6 mo.	Compliance with regulations and standards and in accordance with CDOT's Erosion Control and Storm Water Quality Guide (ECSCG). **Manufactured Systems:** Compliance with manufacturers manuals **Vegetated Biofilters/Filter Strips:** Inspection of slopes and ditch bottom; vegetation management; debris and litter management. **Detention Ponds:** Inspected and checked for compliance with management plan. **Bioretention Cell, Infiltration:** Inspected for excessive ponding; overgrown vegetation, litter/debris; erosion and deposition; and outlet structure clogging **Infiltration Basin/Trenches:** Inspected for debris, overgrown vegetation, level of sedimentation; and condition of observation wells; **Constructed Wetlands:** Effectiveness of vegetation management; absence of erosion, clogging; litter/debris and sediment.	Operate as designed and no instances of non-compliance with regulations and standards and ECSQG. Operate as designed and routine clean-out, removed material sampled and tested in line with manufacturers manuals Filters performing as designed. All systems operate as designed and no instances of excessive ponding, threats to structural soundness of embankments and outlet structures; excessive erosion and sediment, seepage from embankments, overgrown vegetation, outlet clogging or litter/debris.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
2.7	Discharge systems	Surface water discharge systems perform their proper function and discharge to groundwater and waterways complies with the relevant regulations and permits.	24 hrs	28 days	6 mo.	Compliance with regulations and in accordance with CDOT's Erosion Control and Storm Water Quality Guide.	No instances of non-compliance.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.	**STRUCTURES**						
3.1	Structures having an opening measured along the center of the roadway of more than 20 feet between under copings of abutments or springlines of arches or extreme ends of openings or multiple boxes.	Substructures and superstructures are free of: • graffiti • undesirable vegetation • debris and bird droppings • blocked drains, weep pipes manholes and chambers • blocked drainage holes in structural components • defects in joint sealants • defects in pedestrian protection measure • scour damage • corrosion of rebar • paint system failures • impact damage Bridge structures maintain a minimum vertical clearance of 16.5 feet over traveled lanes. Maintain structures to specified condition rating.	24hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Condition Evaluation of Bridges, and the FHWA Bridge Inspector Reference Manual.	Records as required in the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Bridge Evaluation. No occurrence of NBI condition rating below seven for any new deck, superstructure or substructure. No occurrence of NBI condition rating below six for any widened or rehabilitated deck, superstructure or substructure, prior to reconstruction of a new structure. All Pontis condition states to be one or two for all structure components.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.2	Structure component	i) Expansion joints are free of: • dirt debris and vegetation • defects in drainage systems • loose nuts and bolts • defects in gaskets • leaking ii) The deck drainage system is free of all and operates as intended. iii) Barriers are free of: • loose nuts or bolts • blockages of hollow section drain holes • graffiti • vegetation • accident damage iv) Bearings and bearing shelves are clean.	24 hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Condition Evaluation of Bridges, and the FHWA Bridge Inspector Reference Manual.	Records as required in the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Bridge Evaluation. No occurrences of NBI condition rating below seven for any new deck, superstructure or substructure No occurrence of NBI condition rating below six for any widened or rehabilitated deck, superstructure or substructure, prior to reconstruction of a new structure. All Pontis condition states to be one or two for all structure components.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.2 (cont.)	Structure component (continued)	v) Sliding and roller surfaces are clean and greased to ensure satisfactory performance. Additional advice contained in bearing manufacturers' instructions, in the Current CDOT M&S Standard Plans, Standard Specification for Road and Bridge Construction is followed. Special finishes are clean and perform to the appropriate standards. vi) All non-structural items such as hoists and electrical fixings, operate correctly, are clean and lubricated as appropriate, in accordance with the manufacturer's recommendations and certification of lifting devices are maintained. vii) Maintain structures to specified condition rating.					

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.3	Structures – General	Safe operation of structures, maintained to prevent safety issues arising	1 hrs	28 days	12 mo.	Inspection of concrete surfaces adjacent to and above the Roadway	No instances of delaminated concrete above the Roadway.
3.4	Structures – Bridge girders/beams	Design stress is not exceeded in bridge girders/ beams (particularly in skew bridge decks)	1 hrs	28 days	12 mo.	Measurement of out of plumb twisting/rotation of bridge girders/beams.	The out-of-plumb rotation of bridge girders/beams shall not exceed 0.6° or 1/8 in. per ft
3.5	Non-bridge class culverts	Non-bridge-class culverts are free of: • vegetation and debris and silt • defects in sealant to movement joints • scour damage	24 hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Condition Evaluation of Bridges, and the FHWA Bridge Inspector Reference Manual.	Records as required in the current version of the CDOT Pontis Bridge Inspection Coding Guide and AASHTO Manual for Bridge Evaluation. No occurrences of NBI condition rating below seven for any culvert elements. All Pontis condition states to be one or two for all structure components. None with vegetation, debris and silt. None with defects in sealant and movement joints.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.6	Retaining Walls	Maintain retaining walls to be structurally sound, and free of vertical, lateral or rotational movement with no material defects compromising the intended performance.	48 hrs	28 days	12 mo.	Condition of exposed surfaces showing cracking, spalling, leaking, build-up of efflorescence and rust staining.	No more than 5% of a combined retaining wall area of each wall showing cracking with moderate leaking, build-up of efflorescence, delamination's, spalls, and widespread rust staining. No concrete surfaces with spalls greater than 1" deep or to reinforcement level.
						Area of cracks measured as the length of the crack and six inches on either side of the centerline of the crack.	No more than 5% of retaining wall area showing cracking of >1/8".
						Measurement of settlement of spread footing foundations in deviation from constructed elevation.	None greater than 1.5" total or 1/2" in a 5 year period
						Measurement of rotational movement resulting in deviation from constructed alignment using a 10 foot straight edge.	None greater than ½" horizontal movement within 10' vertical.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.8	MSE Retaining Walls	Maintain retaining walls to be structurally sound, and free of vertical, lateral or rotational movement with no material defects compromising the intended performance.	48 hrs	28 days	12 mo.	Panel condition	No more than 5% showing cracking, delamination's, spalls, or scaling per panel or each MSE wall.
						Joint condition	No instances cracks >1/4", on more than one panel per wall. No instances of joints with exposed fabric, MSE backfill material below joint or vegetation growing between joints Panel offset at joints shall not exceed 3/4 inch. Joint opening shall not exceed ¼ inch greater or ½ inch less than the design width along adjoining panels.
						Measured erosion	No instances of erosion >1 feet deep along wall coping, erosion exposing the top of the leveling pad (where pad is not on rock), or exposed straps or mesh
						Measurement of bowed wall: variance from constructed alignment. Change from as built records measured using 10' straight edge.	No instances of variance from constructed alignment greater than 3/4 inch horizontal movement within 10' vertical

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
3.9	Sign structures	Sign gantries are structurally sound and free of: loose nuts and bolts, defects in surface protection systems, graffiti	24 hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of CDOT Signs and Signals Coding Guide.	All condition states to be one or two for all structural members. None with loose assemblies. None with defects in surface protection. None with graffiti.
3.10	Load ratings	All structures maintain the design load capacity	24 hrs	28 days	6 months	Load rating calculations in accordance with the AASHTO Manual for Bridge Evaluation the current version of the CDOT Pontis Bridge Inspection Coding, and CDOT Bridge Rating Manual. Load restriction requirements as per AASHTO Manual for Bridge Evaluation, the current version of the CDOT Pontis Bridge Inspection Coding, and CDOT Bridge Rating Manual.	Comply with load restrictions on new structures for Colorado legal loads (including legally permitted vehicles).

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
4	**ROADWAY MARKING**						
4.1	Pavement markings – General	Pavement markings are: • clean and visible during the day and at night • whole and complete and of the correct color, type, width and length • correctly placed to meet the MUTCD and the Colorado Supplement to MUTCD, as well as the CDOT M&S Standard Plans.	24 hrs	28 days	6 mo.	Compliance with regulations Minimum Average Retro-reflectivity (mcd/m2/lux) measured using a retro-reflectometer having 30-meter geometry - average of 10 readings at approximately 1/10 mile increments or 10 equal increments per ramp less than 1 mile long for long lines: - average of 5 readings for each auxiliary marking Measured minimum presence on the Pavement Surface, including bridge decks Measured pavement markings color Luminance Factor (Cap Y) requirements as prescribed in ASTM 6628 Measured spread of material beyond design line dimension width	100% in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) and the MUTCD -Colorado Supplement Long Lines – White 200 Long Lines – Yellow 125 Auxiliary Markings – White 200 Auxiliary Markings - Yellow 125 Long Lines 90% per 528 ft (1/10th mile) Auxiliary Markings 75% White > 35, Yellow > 25 Not more than 10% of specified dimensions.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
4.2	Reflective markers	Reflective pavement markers (RPM's), are: • clean and clearly visible • of the correct color and type • reflective or retroreflective as required in the MUTCD and Colorado Supplement • correctly located, aligned and at the correct level • are firmly fixed • are in a condition that will ensure that they remain at the correct level.	24 hrs	28 days	6 mo.	Number of pavement markers that are ineffective. (Ineffective includes missing, nonreflective, broken, damaged, settled or sunk) Number of pavement marker casting securely fastened (Category 1 defect) Uniformity; percentage (replacement RPM's having equivalent physical and performance characteristics to adjacent markers.)	Less than 10-percent ineffective in a centerline mile, with no more than two (2) consecutive RPMs missing or non-reflective. 100% 100%
4.3	Delineators & Markers	Object markers and delineators are: • clean and visible • of the correct color and type • legible and reflective • straight and vertical	1 hrs	48 hrs	28 days	Number of object markers or delineators defective or missing	No more than 10% of delineators or markings will be missing or not easily visible in any auditable section.
5	**GUARD RAILS, BARRIERS, IMPACT ATTENUATORS**						

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
5.1	Guard rails and traffic barriers	All guardrails, traffic barriers and other concrete barriers are maintained free of Defects. They are appropriately placed and correctly installed at the correct height and distance from roadway or obstacles.	1 hrs	48 hrs	1 mo.	Length free from Defects (loose nuts/bolts) Surface condition Guardrail installed and maintained at correct height and distance from roadway and obstacle in accordance with relevant standards Posts Spacer Blocks	All nuts, bolts and connections to be properly tightened 90% of surfaces to be free from Defects (spalling of concrete, failure of corrosion protection) within a 12.5 foot section. No Defect greater than 1 foot square or 1 cubic foot of missing material within a12.5 foot section. 100% within 3 inches vertical of correct system height. Vegetation maintained at least 5 feet behind guardrail. No missing posts. No post shall have section loss greater than 25%, No two adjacent post shall have a combined section loss greater than 25%. No missing spacer or rotated blocks. No section loss greater than 10%.
5.2	Impact attenuators, anchor assembly, and end assembly	All impact attenuators, anchor assemblies, and end assemblies are appropriately placed and correctly installed and maintained free of damage	1 hrs	48 hrs	1 mo.	Percentage of impact attenuators, anchor assemblies, and end assemblies correctly placed and installed and free of damage Integrity of the system	100% 100% cell replacement (unit replacement) following

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
6	**SIGNS**						
6.1	General – all sign panels	Signs are clean, correctly located, clearly visible, legible, reflective, at the correct height and free from structural and electrical Defects Identification markers are provided, correctly located, visible, clean and legible Sign mounting posts are vertical, structurally sound and rust free Visibility distances meet those stated in the MUTCD and the Colorado Supplement Sign information is of the correct size, location, type and wording to meet its intended purpose	24 hrs	28 days	6 mo.	Compliance with regulations Retroreflectivity measured in accordance with the requirements of MUTCD and the Colorado Supplement Face Damage Placement Sign information is of the correct size, location, type and wording to meet its intended purpose and requirements of MUTCD and the Colorado Supplement	No missing signs and 100% in accordance with the current edition of the (CMUTCD) Retroreflectivity is no less than that required by MUTCD and the Colorado Supplement for retroreflectivity. No signs with face damage greater than 5% of area or 0% if text is damaged or fading Signs are placed in accordance with Requirements of the MUTCD and the Colorado Supplement 100%

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
6.2	Safety critical signs	Requirements as 6.1, Plus: "Stop," "Yield," "Do Not Enter," "One Way" and "Wrong Way" and all Turn-Prohibition signs are clean, legible and undamaged.	1 hrs	12 hrs	7 days	Safety critical signs functionally legible when viewed from a vehicle travelling at posted speed Sign mounting posts and multi-Post breakaway working as intended.	No instances of signs functionally illegible, no twisting or leaning. No section loss greater than 10%. Post shall be plum. All connections shall be free from defects.
6.3	Illegal Signs	Obsolete or illegal signs are removed from the Project	N/A	48 hrs	N/A	Time for obsolete or illegal signs to be removed	100% compliance

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
7	**Traffic Signals**						
7.1	Traffic Signals - General	i) Traffic Signals and their associated equipment are: · clean and visible · correctly aligned and operational · free from damage caused by accident or vandalism · correctly aligned and operational ii) Signal timing and operation is correct. iii) Contingency plans are in place to rectify Category 1 Defects not immediately repairable to assure alternative traffic control is provided during a period of failure.	1 hrs	24 hrs	6 mo.	Review of maintenance records **a) General condition** Visual inspection **e) Damage** Visual inspection **f) Signal timing** Timed measurements **g) Contingency plans** Records Review	Maintained in accordance with Good Industry Practice Signals are clean and visible 100% of the time Signals are undamaged 100% of the time Installations have correct signal timings 100% of the time Full contingency plans are in place 100% of the time
7.2	Traffic Signals - Electrical Supply	Electricity supply, feeder panels, cabinets, switches and fittings are electrically, mechanically and structurally sound and functioning	1 hrs	24 hrs	6 mo.	Availability of supply of power and electricity to the road lighting system.	A continuous availability level of 100% from metered source to all O&M equipment and facilities.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
7.3	Traffic Signals - Soundness	Traffic signals are structurally and electrically sound	24 hrs	28 days	6 mo.	a) Structural soundness Visual inspection b) Electrical soundness Testing to meet NEC regulations	Inspection records showing safe installation and maintenance
7.4	Traffic Signals - Identification marking	Signals have identification markers and the telephone number of the Developer for reporting faults are correctly located, clearly visible, clean and legible	24 hrs	7 days	N/A	Visual inspection and/or notification	Inspection records showing identification markers and other information are easily readable on 100% of markings.
7.5	Traffic Signals - Pedestrian Elements and Vehicle Detectors	All pedestrian elements and vehicle detectors are correctly positioned and fully functional at all times	1 hr	24 hrs	6 mo.	Visual inspection and/or notification	Inspection records showing safe installation and maintenance

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
8	**Lighting**						
8.1	Roadway Lighting – General	i. All lighting is free from defects and provides acceptable uniform lighting quality. ii. Lanterns are clean and correctly positioned. ii. Lighting units are free from accidental damage or vandalism. v. Columns are upright, correctly founded, visually acceptable and structurally sound.	12 hrs	14 days	N/A	Roadway lighting operable - Night time inspection or automated logs Roadway Lighting out of service - Night time inspection or automated logs Visual inspection and/or notification Visual inspection and/or notification	No sections with less than 90% of lights functioning correctly at all times. No Instances of more than two consecutive lights not working. No damage Columns are plumb, bases are not damaged and no section loss.
8.2	Sign Lighting	Sign lighting is fully operational	12 hrs	14 days	N/A	Night time inspection, automated logs or notification	No Instances of more than one bulb per sign not working.
8.3	Lighting - Electrical Supply	Electricity supply, feeder pillars, cabinets, switches and fittings are electrically, mechanically and structurally sound and functioning.	1 hr	7 days	1 mo.	Testing to meet NEC regulations, visual inspection	Inspection records showing safe installation and maintenance 100% of the time.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
8.4	Lighting - Access Panels	All access panels in place at all times.	1hr	24 hrs	N/A	Visual Inspection or notification	No Instances of missing access panels
8.5	Lighting - Structures	Structurally sound and free of loose nuts and bolts. No defects in surface protection systems. No graffiti.	24 hrs	28 days	6 mo.	Inspection and assessment in accordance with the requirements of CDOT Signs and Signals Coding Guide	All condition states to be one or two for all structural members. No loose assemblies. No defects in surface protection. None with graffiti.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
8.6	Lighting – Fixtures	i. All luminaries functioning on each pole. ii. All obstruction lights are present and working (if required). iii. Compartment door is secure with all bolts in place. iv. All non-structural items such as hoists and electrical fixings, operate correctly, are clean and lubricated as appropriate, in accordance with the manufacturer's recommendations and certification of lifting devices are maintained.	24 hrs	48 hrs	1 mo.	Yearly inspections and night time inspections or automated logs	No instances of two or more lamps not working per high mast pole. No identification of other defects.
9	**FENCES AND WALLS**						
9.1	Fences and Walls - Design and Location	Fences and walls act as designed and serve the purpose for which they were intended	1 hr	28 days	6 mo.	Visual Inspection	Inspection records showing compliance with design
9.2	Fences and Walls - Construction (includes existing)	Integrity and structural condition of the fence is maintained	< 1 hr	28 days	6 mo.	Structural assessment if visual inspection warrants	Inspection records showing compliance with design, and no structural safety issues.
10	**ROADSIDE**						

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
10.1	Vegetated Areas - Except landscaped areas - General	Vegetation is maintained so that: i. Height of grass and weeds is kept within the limits described for urban and rural areas. Mowing begins before vegetation reaches the maximum height. ii. Spot mowing at intersections, ramps or other areas maintains visibility of appurtenances and sight distance. iii. Grass or vegetation does not encroach into or on paved shoulders, main lanes, sidewalks, islands, riprap, traffic barrier or curbs. iv. A herbicide program is undertaken to control noxious weeds in accordance with the EO D 006 99.	24 hrs	7 days	28 days	**Urban areas** Physical measurement of height of grass and weeds **Encroachment** Visual inspection of instances of encroachment of vegetation **Wildflowers** Visual Inspection with audit of process. **Sight lines** Visual inspection	Individual measurement areas to have 95% of height of grass and weeds between 5 in. and 18 in. No occurrences of vegetation encroachment. Adherence to CDOT Roadside Vegetation Management (Final Guideline Document). No instances of impairment of sight lines or sight distance to signs, including control of weeds in pavement and barrier.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
		v. Development and implementation of noxious weed management program to control noxious weeds and to eliminate grass in pavement or concrete.				**Noxious weeds** Visual inspection and/or notification	Not more than 15% (aggregate) of a 1 mile section of roadway contains noxious weeds. Not more than 15% (aggregate) of a 1/10 mile section of ramp contains noxious weeds.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
10.2	Landscaped Areas	i. All landscaped areas are maintained to their originally constructed condition. Landscaped areas are as designated in the plans. ii. Mowing, litter pickup, irrigation system maintenance and operation, plant maintenance, pruning, insect, disease and pest control, fertilization, mulching, bed maintenance, watering is undertaken as per MMP. iii. The height of grass and weeds is kept between 6“ and 8”. Mowing begins before vegetation reaches a hazardous condition, such as sight distance, blocking reflectors, hiding animals or causing drifting snow.	24 hrs	7 days	28 days	Visual inspection Roadside appearance is excellent, characterized by well-tended landscaping and vegetation.	The percent of landscaping area meeting the General Requirement is more than 95%.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
10.2 (cont.)	Landscaped Areas	iv. Damaged or dead vegetation is replaced.					
10.3	Fire hazards	Fire hazards are controlled	12 hrs	14 days	N/A	Instances of dry brush or vegetation forming a fire hazard	No instances of plant material that is a fire hazard
10.4	Trees, brush and ornamentals	v) Trees, brush and ornamentals on the right of way, except in established no mow areas, are trimmed in accordance with CDOT standards. vi) Trees, brush and ornamentals are trimmed to insure they do not interfere with vehicles or sight distance, or inhibit the visibility of signs or shading on the road. vii) Dead trees, brush, ornamentals and branches are removed. Potentially dangerous trees or limbs are removed.	24 hrs	7 days	28 days	Visual inspection and/or notification	Inspection records showing 100% compliance

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
10.4 (cont.)	Trees, brush and ornamentals	iv) All undesirable and unplanned trees and vegetation are removed. Diseased trees or limbs are treated or removed by licensed personnel.					
10.5	Wetlands	Wetlands are properly managed, and in accordance with applicable permit requirements.	24 hrs	28 days	N/A	In accordance with applicable permit requirements	No Instances of permit requirements not me
10.6	Water Quality Ponds	Maintenance of all vegetation within the pond area	24 hrs	7 days	28 days	Visual inspection of ponds	Maintained as required per the design
11	**EARTHWORKS & EMBANKMENTS**						
11.1	Slope - Stability	All structural or natural failures of the embankment and cut slopes on the Site are repaired	1 hr to respond	28 days	6 mo.	Visual inspection by geotechnical specialist and further tests as recommended by the specialist	Recorded instances of slope failure
11.2	Slopes - General	Slopes are maintained in general conformance to the original graded cross-sections	24 hrs	28 days	6 mo.	Areas where replacement fill and of landscaping materials, reseeding and re-vegetation for erosion control purposes and removal and proper disposal of all eroded materials from the roadway and shoulders are required.	No slope failures. Inspection records showing compliance

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
12	**GRAFFITI**						
12.1	Graffiti	Graffiti is removed	24 hrs	10 days	N/A	Removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces. All graffiti is considered a Category 1 Defect.	Inspection records showing 100% compliance
12.2	Offensive Graffiti	Offensive graffiti is removed	1 hr	10 days	N/A	Removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces. All graffiti is considered a Category 1 Defect.	Inspection records showing 100% compliance
13	**INCIDENT RESPONSE**						
13.1	General	Respond to Incidents in accordance with the Incident Response Plan.	1 hr	N/A	N/A	Incident Response Plan. No complaints from Emergency Services.	Response times met for 98% of Incidents measured on a 1 year rolling basis.
13.2	Spillage of Hazardous Materials	For any hazardous materials spills, comply with the requirements of Schedule 17.	1 hr	1 day	N/A	Incident Response Plan details the process and procedures in place and followed.	Inspection records showing compliance

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
13.3	Elements damaged as a result of Incident - Structural Assessment	Evaluate damage to structures and liaise with emergency services to ensure safe working in clearing the Incident.	1 hr	1 day	N/A	Inspections and surveys of relevant Elements as required. (Note. CDOT staff bridge office shall be notified immediately to complete an inspection.)	Inspection records showing 100% compliance
13.4	Elements damaged as a result of Incident - Temporary and permanent remedy	Propose and implement temporary measures or permanent repairs to Defects arising from the Incident. Ensure the structural safety of any structures affected by the Incident.	24 hrs	14 days	6 mo.	Review and inspection of the relevant Elements.	Inspection records showing 100% compliance.
14	**MAINTENANCE YARD**						
14.1	Developer Identification Signs	Signs installed at the entrance(s)/exit(s) to/from the Maintenance Yard	7 days	30 days	12 mo.	Signs installed depicting the name and contact information for Developer	Signs functioning as designed.
14.2	Environmental contamination	No increase in contamination.	2 hr	48 hr	6 mo.	Environmental site assessment or other inspections, as necessary.	No increase in contamination during the Operating Period.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
14.3	Maintenance of grounds and buildings	Kept in a neat and tidy order. Kept structurally safe.	24 hr	7 days	6 mo.	Good housekeeping practice used to maintain buildings and land in a well maintained and neat condition, free from environmental damage. Regular inspection performed.	100% compliance
15	**SNOW AND ICE REMOVAL**						
15.1	Response Time, material application vehicle	The manning and loading of material application vehicles for a Precipitation Event	½ hr	N/A	N/A	All spreading vehicles on any route ready to load anti-icing or de-icing materials within ½ hour as measured by winter operation records and AVL system monitoring.	The required maximum time to complete the manning and loading of material application vehicles for an event is 0.5 hours from the time precipitation has started.
15.2	Response Time, plowing vehicle	The manning of a snowplow vehicle for a Precipitation Event	½ hr	N/A	N/A	All snowplow vehicles on any route have left the yard and ready to begin work within ½ hour as measured by winter operation records and AVL system monitoring.	The required maximum time to complete the manning of snowplow vehicles for an event is 0.5 hours from the time precipitation has started to the time the unit has left its yard to begin work.
15.3	Plowing and material application	Continuous plowing and material application	N/A	24 hr	N/A	All units operating as measured by winter operation records and AVL monitoring systems.	Once operations have begun, all units as identified in the Snow and Ice Control Service Plan shall operate continuously on all routes until all required service levels have been achieved.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
15.4	Circuit time	Complete one entire route within 1 hour	1 hr	N/A	N/A	AVL systems monitoring and/or winter operation record	Circuit time shall be 1 hour from the time a winter unit begins its plowing and/or material application route until the time it is complete.
15.5	Snow accumulation	Remove snow accumulation adjacent to median barrier walls	1 hr	N/A	N/A	Measured by visual inspection, winter operation record	Snow adjacent to median barrier walls is removed concurrently with I-70 Mainline snow removal on the traveled lanes.
15.6	All lanes and ramps	Bare and wet pavement during the Precipitation Event	1 hr	N/A	N/A	Visual inspection and AVL system monitoring	Maintain Bare and Wet pavement during the precipitation event
15.7	Paved shoulders (other than median shoulder)	Bare and wet pavement during the Precipitation Event	8 hr	N/A	N/A	Visual inspection and AVL system monitoring	100% compliance
15.8	Hazards	Address any hazard immediately upon detection or notification	1 hr	N/A	N/A	Visual inspection, AVL system monitoring, or notification	100% compliance
15.9	Isolated slippery conditions	Address isolated slippery conditions.	1 hr	N/A	N/A	Visual inspection, AVL system monitoring, or notification	No isolated slippery sections

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
15.10	Winter Snow and Ice Materials storage	Winter snow and Ice materials stored in covered buildings at all times.	**	24 hr	N/A	** Noncompliance is a Category 1 Defect.	No instances of uncovered storage of winter de-icing/anti-icing materials
15.11	Reporting requirements	All reporting requirements identified in Schedule 11 are accurate, complete, and timely 100% of the time.	1 day	7 days	1 mo.	Audit records and AVL system monitoring.	100% accuracy.
15.12	Automated Vehicle Locator system	All identified vehicles equipped with on board AVL at all times, as required in Section 12 of this Schedule 11	N/A	24 hrs	1 mo.	Random audit, AVL system monitoring.	95% of all AVL units operational 100% of the time. No loss of data due to network service loss.
15.13	Material Spreader calibration	Spreader controller (including winter liquids) calibration is operational.	N/A	24 hrs	N/A	Random audit, AVL system monitoring	95% units operational 100% of the time
15.14	Winter Drainage	Melting snow and ice causing flooding.	1 hr	6 hrs	N/A	Visual inspection, AVL system monitoring	No flooding on roadway caused by snow and/or ice impeding drainage through or to drains, culverts and ditches.
16. Courtesy Patrol							

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
16.1	Courtesy Patrol	Provide full number of patrol vehicles each shift	**	1/2hr	N/A	** Noncompliance is a Category 1 Defect. Measured by patrol records	100% of the time
16.2	Courtesy Patrol	Respond to any calls on the General Purpose Lanes or Tolled Express Lanes 30min after being dispatched.	**	1/2hr	N/A	** Noncompliance is a Category 1 Defect Measured by patrol records	100% of the time
17. Sweeping and Cleaning							
17.1	Sweeping	i) Keep all channels, hard shoulders, gore areas, ramps, intersections, islands and frontage roads swept clean. ii) Clear and remove debris from all paved areas other than as required in Section 1.1 of this Appendix A-2. iii) Remove all sweepings without stockpiling in the right of way and dispose of at approved site.	12 hrs	14 days	6 months	Visual Inspection of buildup dirt, ice, rock, debris (from accidents and/or otherwise).	Inspection records showing 100% compliance

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
17.2	Litter	i) Keep the Site in a neat condition, remove litter regularly ii) Pick up large litter items before mowing operations. iii) Dispose of all litter and debris collected at an approved solid waste site.	24 hrs	14 days	6 months	Visual Inspection of pieces of litter.	Inspection records showing 100% compliance
18.	**Cover**						
18.1	Snow and ice removal	Snow and ice removal in the Cover section and at access and egress points	1/2hr	6 hrs	N/A	Visual observation and/or AVL system monitoring.	No snow or ice along the Cover structure wall and soffit. No snow or ice along the right shoulder at the access and egress points.
18.2	Subsurface structures	All subsurface structures, including passive fire protection, shall be free of Defects.	1hr	6 hrs	N/A	All subsurface structures maintained in accordance with National Tunnel Inspection Standards, Highway and Rail Transit Tunnel Inspection Manual, 2005, Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005 and the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual.	Elements maintained free of Defects

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.3	Structural supports and Connections for all miscellaneous structural attachments or supports.	Structural Supports & Connections for all miscellaneous structural attachments or supports shall be free of defects.	1hr	6 hrs	6 mo.	All structural supports maintained in accordance with National Tunnel Inspection Standards, Highway and Rail Transit Tunnel Inspection Manual, 2005, Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005 and the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual.	All Elements with full capacity connections in accordance with the design and manufacturer's requirements Sections free of loss of connection material due to impact, corrosion, or wear. Free of loose connections or bolts. Free of deterioration or damage of base structure material. Free of movement of supported item. Free of excessive vibration of supported item.
18.4	Retaining Walls	As a minimum free of the Defects as identified in the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" Chapter 4, Section A and Section 3 Structures of this Appendix A-2	1hr	6 hrs	6 mo.	Compliance with Maintenance Management Plan (MMP). The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual and in accordance with Section 3 Structures of this Appendix A-2.	All Elements maintained free of Defects.
18.5	Waterproofing	Leaks in subsurface structures.	24 hrs	28 days	6 months	Visual Inspection	The subsurface structures shall be free of leaks.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.6	Finishes	All finishes shall be free of Defects and clean.	24 hrs	28 days	6 months	Visual inspection and in accordance with the FHWA Highway and Rail Transit Tunnel Inspection Manual, 2005, Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005 and the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual	Maintaining level of reflectivity and brightness consistent with lighting level criteria, free of loose or damaged finish materials with fully functional emergency equipment such as exit signage, lights, emergency panels, fire alarm boxes, signage and communications equipment and maintain colors and design characteristics consistent with aesthetic requirements.
18.7	Drainage	Subsurface drainage and pumping systems fully operational and clear of debris.	2 hrs	48 hrs	1 month	Regular inspection in accordance with the FHWA Highway and Rail Transit Tunnel Inspection Manual, 2005, Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005 and the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual	Maintenance performed and documented per the Maintenance Management Plan (MMP) with flow rates established per design, free from blockage due to sedimentation or calcification and, fully functional pumping components and systems, screeds, and control and monitoring equipment.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.8	Fire Protection	Fire protection systems such as but not limited to fire detection, alarm, notification and suppression systems fully functional and operational.	1 hr	12 hrs	3 months	Compliance with Maintenance Management Plan MMP. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual and applicable NFPA standards. Life Safety preventative maintenance performed and reported bi-annually.	Fire protection systems functioning correctly and in compliance with MMP 100% of the time
18.9	Electrical Systems, regular & Emergency Lighting	Lighting system fixtures, lamps and control functioning to provide the intended illumination level, light output, lighting quality, duration and energy efficiency, for the location	1 hr	12 hrs	3 months	Compliance with Maintenance Management Plan (MMP). The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual.	Electrical and emergency lighting systems functioning correctly and in compliance with MMP 100% of the time

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.10	Electrical Systems, Fire / vehicle Detection and Alarm and emergency way-finding signage	Fire / vehicle detection and alarm systems provide the intended detection and notification functions including emergency way-finding signage.	1 hr	12 hrs	3 months	Compliance with Maintenance Management Plan (MMP). The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual, manufacturer's recommendations, NFPA 70B and 72. Preventative maintenance of fire alarm sources and testing per NFPA 70B, 72, 101, 110 & 111. Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding. Continuous monitoring through self-system diagnostics and failure detection.	All fire alarm systems perform as designed and provide the intended level of protection with all detectors operating within manufacturer's tolerance for sensitivity and cleanliness. All inspections conducted and documented. All preventative maintenance performed and documented in accordance with the referenced standards.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.11	Electrical Systems, Communications including Radio Rebroadcast, 2-way Radio, public emergency message rebroadcast, voice alarm and public address, Telephone and CCTV	Communications systems serving their intended functions	1 hr	12 hrs	3 months	Compliance with Maintenance Management Plan (MMP).The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual and manufacturer's recommendations. Operational tests using 2- way radio equipment and frequencies to match outside agencies served, weekly. Continuous monitoring through self-system diagnostics and failure detection. CCTV system compliance with NFPA 72 inspection and maintenance requirements for fire detection, where used.	All equipment operating in accordance with manufacturer's recommendations for actual conditions of use. 2-way radio system performance conforming with up-to-date Department specifications. Public emergency message rebroadcast performance conforming with relevant standards. Voice alarm and public address performance conforming with relevant standards. CCTV system complying with all requirements required to function as second means of fire detection. All inspections conducted and documented. All preventative maintenance performed and documented in accordance with the referenced standards and MMP.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.12	Electrical Systems, Distribution – Normal, Essential & Emergency	Electrical system serving connected loads with intended capacity, voltage regulation, protection, control and monitoring.	1 hr	12 hrs	3 months	Compliance with Maintenance Management Plan (MMP). The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual and manufacturer's recommendations. Preventative maintenance and testing of essential and Emergency sources per NFPA 110 and 111. Exercising of back-up generators under load where used as essential and Emergency sources, monthly. Exercising of ATS switches, semi-annually. Load testing of UPS systems where used as essential and Emergency source, monthly. Monitoring and Testing of individual battery cell condition, annually.	All elements of electrical systems distribution normal, essential and emergency functioning as designed 100% of the time.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.13	Command, Control and Monitoring System	Command, Control and Monitoring System provides intended function of control, monitoring, communication and visual display of all connected systems including integration with other systems.	1 hr	12 hrs	3 months	Compliance with Maintenance Management Plan (MMP). The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding. Continuous monitoring through self-system diagnostics and failure detection.	All elements of Command, Control and Monitoring System systems functioning as designed 100% of the time.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.14	Electrical Systems, Grounding & LP	Grounding and lightning protection systems provide intended function and level of protection for equipment, structure and personnel protection.	2 hrs	24 hrs	3 months	Compliance with Maintenance Management Plan (MMP). The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual, manufacturer's recommendations and NFPA 780. The fall of potential method shall be used to test the resistance to earth of all grounding electrode systems serving electrical services, lightning protection and alternate energy sources, every 5 years. The continuity of ground connections to remote earth shall be tested during replacement of equipment served or any major change of system configuration.	All elements of Grounding and lightning protection systems functioning as designed 100% of the time.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.15	Ventilation System	Ventilation system fully maintained, functional and operational.	2 hrs	24 hrs	3 months	Compliance with Maintenance Management Plan (MMP). The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, the Tunnel, Operations, Maintenance, Inspection, Evaluation (TOMIE) Manual, and manufacturer's recommendations. Life Safety preventative maintenance performed and reported bi-annually. Life safety components of the tunnel ventilation system tested annually, Verification of OCC activation and separately, local activation of tunnel ventilation life safety response, annually.	All elements of the ventilation system functioning as designed 100% of the time.
18.16	Cover electrical Supplies	Electricity supplies, feeder panels, transformers, cabinets, switches and fittings are electrically, mechanically and structurally sound and functioning	1 hrs	24 hrs	1 mo.	Availability of supply of power and electricity to the cover systems.	A continuous availability level of 100% from metered source to all O&M equipment and facilities.

REF	ELEMENT	GENERAL REQUIREMENT	DEFECT REMEDY PERIOD			PERFORMANCE REQUIREMENTS	
			Cat 1 Immediate Action	Cat 1 Permanent Remedy	Cat 2 Permanent Repair	MEASUREMENT CRITERIA	TARGET
18.17	Cover firefighting Water Supplies	Firefighting water supplies, plumbing, pipework and valves mechanically and structurally sound and functioning	1 hrs	24 hrs	1 mo.	Availability of supply of firefighting water to the cover systems.	A continuous availability level of 100% to all firefighting equipment and facilities.
18.18	Plant rooms	Electricity supplies, panels, cabinets, switches, heating/cooling/air conditioning and fittings are electrically, mechanically and structurally sound and functioning	1 hrs	24 hrs	3 mo.	Availability of equipment and systems to the cover systems.	A continuous availability level of 100% to all O&M equipment and facilities.
19.	**ITS EQUIPMENT***						
19.1	ITS Equipment installed by Developer	Fully function and operational without damages.	NA	24hr	48hr	Operation records; Visual Inspection	No instances of malfunction or damages to devices or equipment.
19.2	Backbone communication and VTMS	Fully functional and operational without damages.	NA	4hr	24hr	Operation records; Visual Inspection. Follow manufacturer's recommendations for maintenance and testing. Continuous monitoring through self-system diagnostics and failure detection.	No instances of communication or VTMS failures.

*For the period commencing the operations of the ITS and/or Tolling Equipment installed by the Developer, up to two Calendar Years after Final Acceptance.

Appendix B – Courtesy Patrol Requirements

1.1 GENERAL REQUIREMENTS:

A. Location
   1. I-70 Mainline, within the O&M Limits

B. Hours of Operation:

   1. Peak Hour Patrolling, requires 3 Courtesy Patrol Vehicles.

      The peak hour patrol segment hours of operation shall be 06:30 A.M. to 09:30 A.M. and 3:00 P.M. to 7:00 P.M., year round. Developer shall patrol each segment every weekday (Monday through Friday), except the following holidays: **New Year's Day, Thanksgiving Day, and Christmas Day**; holiday work days may be modified if requested by the Department, in writing, 72 hours in advance. The Developer shall patrol regardless of weather.

      Peak period hours of operation may be modified by the Department, with notice in writing, 72 hours in advance.

   2. Weekend Patrolling, requires 1 Courtesy Patrol Vehicle.

      The weekend patrol hours of operation shall be 10:00 A.M. to 7:00 P.M., year round. The Developer shall patrol each segment every weekend (Saturday and Sunday), except the following holidays: **New Year's Day, Thanksgiving Day, and Christmas Day**; holiday work days may be modified if requested by the Department, in writing, 72 hours in advance. The Developer shall patrol regardless of weather.

      Weekend hours of operation may be modified by the Department, with notice in writing, 72 hours in advance.

C. Any extensions of operating hours due to emergencies, severe weather or planned special events shall be the responsibility of Developer

D. Developer shall respond with vehicle enroute to any calls on the Tolled Express Lane(s) or General Purpose Lane(s) within Thirty (30) minutes of being dispatched from the Departments call center or authorized Department representative. All vehicles shall be towed to a designated drop point. Drop Sites may be different than the ones that are being required by the Project patrols which are only required to be open until 11:00 pm during the week. These drop sites will meet all other Project patrol requirements. However, these locations will be open on the weekends and will be open twenty four hours a day, i.e. 7-11 stores. Furthermore, Incidents or accidents will be moved to the nearest shoulder (a location that is safe to all) to open all lanes of the Tolled Express Lane(s). Developer shall use flat-bed or wrecker tow trucks to remove vehicles from the scene, and these trucks shall meet the requirements in this Schedule 11 and contain all the equipment that is set forth by the Colorado PUC. Vehicles shall be relocated from the Tolled Express Lane(s), which is not safe for motorist to be assisted. No gas, tire change, or jump start shall be given to anyone in the Tolled Express Lane(s) due to the danger of the location. Cell phones shall be provided for emergency uses only.

E. Developer shall provide the Courtesy Patrol Service vehicles needed to perform the assistance services mentioned above.

F. Developer shall not pass beneath the transponder trellis for the Tolled Express Lane(s) lane when providing routine patrolling. Doing so will result in issuance of a toll fee to Developer. Developer shall be solely responsible for paying the toll fee which may vary by time of day. When responding to service calls, or when directed by Department, Emergency Services, or a Governing Authority, the Developer shall use Tolled Express lane to ensure the quickest arrival to the Incident or disabled vehicle. Tolled Express Lane(s) fees will be reimbursed to the Developer based on a log filled out by the operators and actual toll invoice from the tolling authority. Comply with all laws regarding travel on the shoulders of any highway areas.

1.2 SPECIFIC WORK REQUIREMENTS:

A. Work Requirements:
Developer shall provide such services according to the following requirements:

1. All services shall, at all times, be provided by Developer free of any charge to, or payment from, the disabled motorists or any other person or entity, public or private. Developer shall refuse any offers of other payment or gratuities of any kind.
2. Developer shall provide the services to disabled motorists only after Developer explains to the motorist the services to be provided (including the drop site, and that the services are free of charge), and only after requesting and obtaining the motorist's consent to such services. The services may be refused by the motorist at any time.
3. Subject to the motorist's consent, it is preferable for the Developer to move the vehicle from traffic or from the shoulder (whichever is applicable) off of the highway to a drop site before providing additional services, in order to eliminate any hazard or congestion that might result if Developer provided service in traffic or on the shoulder.
4. The motorist may choose to have Developer leave the vehicle in traffic, or to have Developer move a disabled vehicle that is in traffic to the shoulder of the highway and provide limited assistance to the vehicle on the shoulder, rather than to have the Developer move the vehicle from the highway to a drop site. In the event the motorist chooses not to have their vehicle moved from the travel lane to the shoulder or drop site, the Developer will protect the scene by pulling behind the disabled vehicle, activating flashing lights and contacting the local law enforcement agency for assistance.
5. Developer shall provide service(s) chosen by the motorist, however, Developer shall not provide any service not described herein.
6. Developer shall report all occurrences causing traffic congestion, all Incidents requiring the Developer to be in and out of service, and each beginning and ending shift to the Department designated dispatcher when the event occurs.

B. Drop Sites:
Developer shall obtain the right to use suitable "Drop-Sites" near the Project.

A "Drop-Site" is defined as any business location to which the Developer can tow (and leave) the disabled vehicle, and from which the motorist of the disabled vehicle can safely make arrangements to be picked up and/or to have the vehicle repaired, subject to the specific conditions described below.

1. Specific Drop-Site Conditions

Drop-sites shall satisfy all of the following specific conditions:

a. The site(s) shall be located as close as reasonably possible to the highway, and within the Project limits.

b. The sites shall be well lighted and must have a working phone (pay or business) available to the public on the premises.

c. The site(s) shall be businesses, and must be open at all times during patrolling/towing hours and for at least two hours after the end of that patrol's hours of operation. (It is preferable, but not required; that each business Drop Site be able to provide assistance to the disabled vehicle, e.g. full service gas stations, tire stores, or other repair facilities.)

d. Businesses used as Drop Site (s) must allow a disabled vehicle to remain on site, free of charge, for at least three hours, in order to provide sufficient time for the motorist to make suitable arrangements.

e. The Developer shall have written evidence from the owner/operator of the business of the Developer's right to use that business as a Drop Site.

2. General Drop Site Requirements

The Developer shall also comply with the following general requirements concerning drop sites.

a. Developer shall not receive any payment or compensation of any kind from such businesses in connection with, or as a result of, the program services, including for any repairs made to the vehicle by the business.

b. The particular Drop Sites used by the Developer may vary from hour to hour, depending on the conditions at each site during the hours of operation of the patrol.

c. Developer shall provide a list of Drop Sites, listed by hour each Drop Site is available for use, to the Colorado State Patrol and to any local law enforcement agency with jurisdiction over such sites immediately upon commencement of the O&M Work. Developer shall also provide any modification of such list to such agencies and Department, within one (1) working day of that modification.

d. As described above, Developer shall obtain the motorist's consent to move the motorist and the disabled vehicle to a drop site. The Developer shall explain to the motorist that they have only three hours at the Drop Site to make suitable arrangements or their vehicle can be towed away at their expense.

e. Developer shall be solely responsible for any motorist injury or vehicle damage resulting from Developer's selection or use of a particular Drop Site.

f. Developer shall not leave a motorist and/or a disabled vehicle at a particular Drop Site if, under the circumstances, that Drop Site presents an unreasonable risk of harm to the motorist or vehicle.

C. Work Prohibitions:

The success of this Courtesy Patrol program relies heavily on public relations and on the public's perception of the program's purposes and operation and, therefore, on the conduct of Developer and its operators in performing the program services.

The Department has determined that all of the actions listed below would create a negative public image, present a problem for local law enforcement concerning traffic management, and interfere with the operation and success of the program. Therefore, at all times during the performance of the Courtesy Patrol Services, Developer, its operators, and its employees shall not:

1. Solicit membership in any commercial/business organization or association, including vehicle repair or service associations.
2. Recommend or pressure motorists to use any towing service other than the Courtesy Patrol for a disabled vehicle.
3. Recommend, or pressure motorists to use, any business (including drop-site businesses) for service on a disabled vehicle.
4. Radio for an alternative towing service, except when specifically asked by a motorist to do so, after the free Courtesy Patrol Services have been offered and explained to the motorist.
5. Tow a vehicle to a location other than the shoulder of the highway segment, or to the designated drop-site nearest the vehicle location.
6. Interfere with a private sector towing service that is already present at the immediate location of a disabled vehicle. When Developer arrives at the vehicle in such circumstances, the Developer should stop and offer assistance only to the motorist.
7. Patrol near another Courtesy Patrol Services vehicle off the Project limits.
8. Stay at the scene of an accident on the highway segment after the local law enforcement authorities have arrived at the scene, unless requested by local authorities to assist at the accident scene.
9. Refuse the orders of a law enforcement officer, or any directions the Department, or his/her designee, as provided to the Developer.
10. Tow a disabled vehicle while the motorist, or other occupants of the disabled vehicle, are in the towed vehicle, or leave any unattended occupants on the freeway while towing the vehicle. Operator shall contact Department dispatcher and request alternate transport of such occupants (e.g. other Courtesy Patrol Service or police vehicle).
11. Accept tips, money, or any other payment or compensation of any kind from the disabled motorists for the services provided.
12. Patrol with any other person in the patrol vehicle, unless that person is directly associated with the program/Developer.
13. Commit traffic violations of any kind including without limitation, speeding, or illegal lane changes.
14. Perform any act that provides an unfair competitive advantage to any private tow service.
15. Use the vehicle's yellow warning lights other than as authorized by law. The yellow warning lights shall be activated only when the vehicle is operating on the roadway to eliminate hazards to other traffic, as required by Colorado Revised Statutes 42-4-214.
16. Complete services as a private tow service when services were initiated as Courtesy Patrol Service. This includes staying at the scene of an Incident until the end of patrol hours, removing Courtesy Patrol Service signs, and then performing services as a

private tow service for a fee. Courtesy Patrol Service signs shall be put in-place before entering, and removed and upon leaving, the freeway.

Developer will notify the Department of any of its operators/employees who perform such actions and, upon receipt of such notice; the Developer shall take immediate action to remove such operators/employees from further performance of program services.

D. Patrolling:

At the beginning of a shift, the Developer shall dispatch the appropriate number of Courtesy Patrol Service vehicles to begin patrolling on the Project and designated number of specially equipped Courtesy Patrol Service towing vehicles for staged operations. The two vehicles must start at opposite ends of the Project, traveling in opposite directions; or as approved by the Department. The operators/drivers of such vehicles shall be sufficiently spaced to adequately provide continuous coverage during a shift. Vehicles must be patrolling at the beginning of the shift and not in-route, or being acquired.

The Courtesy Patrol Service vehicle(s) shall continuously patrol the designated highway segment for disabled vehicles in need of assistance and, upon finding such vehicles, remove such vehicles from the traveled portion of the highway segment and/or providing assistance to such vehicles as quickly as possible.

Developers' operators shall not park a Courtesy Patrol Service vehicle during hours of operation and wait for an Incident, rather they shall constantly patrol during their assigned shift except when otherwise providing disabled vehicle service(s).

When a disabled vehicle Incident/accident is discovered, the patrol vehicle shall respond as follows:

1. Arriving At a Disabled Vehicle on the Shoulder:

When a Developer operator finds a disabled vehicle on the shoulder of a highway segment, the operator shall pull directly behind the vehicle. However, the operator shall not turn on the towing vehicle's yellow warning lights unless the disabled vehicle or the towing vehicle poses a hazard to other motorists.

The operator shall communicate data collection requirements to the CTMC dispatch for detection (if the operator is the first to identify the Incident) and verification (location of the Incident based on the initial radio report).

The operator shall then exit the patrol vehicle, distribute Department's program brochure, and offer the program services to the motorist. Following directives provided by the Department, the operator shall explain to the motorist:

a. The Courtesy Patrol is a Department program;
b. The program is publicly funded;
c. The services are free of charge to the motorist;
d. Quick Clearance Benefits;
e. The motorist has the option to refuse or accept the service;
f. Only particular services may be provided to the motorist (as defined below);
g. The nature of the drop site(s) available; and

h. The motorist has the option to leave his/her vehicle on the shoulder of the freeway or to be taken to a drop-site.
i. Law enforcement may provide authorization to override a motorist's refusal to move the vehicle.

Developer's operator shall then request the motorist's consent, to such service, and must obtain such consent - in writing, before providing service.

The Developer's operator shall offer to allow the motorist to use the mobile telephone equipment in the Courtesy Patrol Service vehicle, and the motorist shall be allowed up to five minutes of local calls at no charge to the motorist.

If the motorist refuses the service, Developer's operator shall contact the Department's dispatch to determine if the operator should leave the scene to continue patrolling or protect the vehicle until law enforcement arrives.

If the motorist consents to service and, if the operator can make the vehicle operational by providing the limited assistance available to the Developers operator, then the operator shall proceed as follows:

a. If the motorist does not consent to have the vehicle moved, and the operator can render service on the shoulder with minimal hazards created, then the operator will render such service on the shoulder for a period not to exceed 10 minutes. If the operator cannot make the vehicle operational within 10 minutes then, with the motorist's consent, the operator shall move the disabled vehicle and motorist to the drop-site nearest the location of the vehicle. If the motorist does not consent to moving the disabled vehicle and the operator has offered all available options of the Courtesy Program to the motorist, the operator shall notify his/her supervisor and the appropriate law enforcement agency then leave the scene immediately and continue patrolling, unless dispatch and/or law enforcement direct them to stay on scene.
b. If the motorist does consent to have the vehicle moved, it is recommended that the vehicle be moved to the nearest drop-site to provide assistance.

After the vehicle is moved to the shoulder or if the operator provides assistance on the shoulder the operator shall notify CTMC dispatch that the lane is clear. When the disabled vehicle and the motorist are moved safely to the drop-site and/or assistance provided at the drop-site, the operator shall notify the CTMC dispatch that the Incident has been removed from the roadway and shoulder. The operator shall immediately return to patrolling.

2. Arriving At a Disabled Vehicle in Traffic:

When Developer's operator finds a disabled vehicle in traffic, the operator shall pull directly behind the vehicle as soon as possible, and turn on the tow vehicle's yellow warning lights.

Developer's operator shall communicate data collection requirements to the CTMC dispatch for Detection (if the operator is the first to identify the Incident) and Verification (location of the Incident based on the initial radio report).

Developer's operator shall then ask for the motorist's consent to move the disabled vehicle, and the motorist, to a drop-site (first choice), or to the shoulder of the highway segment (second choice). If the motorist consents, the operator shall take appropriate action and inform the Department's dispatcher of the Incident's status, when the blocked lane has been cleared, and when the Incident has been removed from the roadway and shoulder. Developer's operator shall then exit the vehicle and explain the Departments program to the motorist, and the services available.

If the motorist refuses, the operator shall immediately contact local law enforcement to report the disabled vehicle in traffic, and the operator shall stay directly behind the disabled vehicle with yellow warning lights activated until the vehicle is moved from traffic or until a local law enforcement officer arrives. The operator shall follow the instructions of the local law enforcement officer and inform the Departments dispatcher of the Incident's status.

3. Arriving At an Accident:

When the operator finds an accident on the highway, the operator shall pull directly behind the vehicle(s) as soon as possible and turn on the yellow warning lights. The operator should then carefully exit the patrol vehicle and discuss the situation with the motorist(s).

The operator shall communicate data collection requirements to the CTMC dispatch for detection (if the operator is the first to identify the Incident) and verification (location of the Incident based on the initial radio report).

If there are injuries, the operator shall not attempt to move the vehicle(s), but rather immediately call 911 and discuss further action with local law enforcement. The operator shall follow all instructions made by local law enforcement and inform the Departments dispatcher of the Incident's status.

lf there are no injuries (accident involves only property damage) but the vehicle(s) cannot be safely driven, the operator shall explain the program to the motorists and ask the motorist's consent to move the vehicles from the traveled portion, median, or ramp of the highway and inform the Departments dispatcher of the Incident's status.

If the motorist does not consent, then the operator shall stay immediately behind the vehicles until local law enforcement arrives, shall assist law enforcement as requested, and inform the Departments dispatcher of the Incident's status.

If the motorist consents, the operator shall request additional Courtesy Patrol assistance before taking further action. (The operator should not move one of the vehicles if that means the other disabled vehicle will remain alone in traffic, but instead protect the accident scene by staying directly behind both vehicles until assistance arrives). If the motorists have already fulfilled the requirements of Colorado Revised Statutes 42-4-1603, concerning exchanging

identification/information, then when assistance arrives, the operator(s) should move the disabled vehicles to the nearest drop-site if damages appear to total less than $1,000.00 (indexed). If the motorist(s) have not exchanged such information, then the operator(s) shall move the vehicles to the nearest suitable location for that purpose in accordance with C.R.S. 42-4-1602(2)**.**

Under no circumstances shall an operator attempt to repair an accident vehicle in an attempt to make it mobile.

The operator shall communicate data collection requirement to the CTMC dispatch when the Incident has been moved from the travel lanes and when the Incident has been removed from the roadway and shoulder.

1.3 SPECIFIC EQUIPMENT REQUIREMENTS:

The Courtesy Patrol Service roving fleet shall contain at a minimum 50% towing vehicles, the remainder of the fleet (maximum of 50%) shall be motorist assistance vehicles. Patrol routes shall have a maximum of one motorist assistance vehicle per segment, unless otherwise approved by the Department.

A. The Courtesy Patrol Service vehicles shall be equipped, at a minimum, with the following:

Towing Vehicles:

1. Wheel lift towing equipment, including safety straps with a minimum lift rating of 3,000 pounds;
2. Hydraulic boom lift capability with a static rating of 5,000 pounds;
3. Winch cable with an 8,000 pound rating on the first layer of cable;
4. Towing slings rated at 3,000 pounds;
5. Tow chains of 5/16" alloy or OEM specs, and J.T. hook assembly;
6. Yellow/amber warning lights with front to rear (360 degree) directional flashing, with on/off switch in cab;
7. Power outlets ("hot boxes"), front mounted , with outlets compatible with 12-volt booster cables;
8. Heavy duty, 60+-amp battery;
9. Two-way radio communications with base office;
10. Cellular telephone;
11. Cab Lighting;
12. Rear work lights;
13. Safety D-ring on rear of truck;
14. Floor jack on rollers with a 2-ton rating;
15. All equipment necessary to operate the towing vehicles during winter driving conditions (i.e. chains, studded snow tires, etc.);
16. Wrap around push bumpers; and
17. Automated Vehicle Location (AVL)

Motorist Assistance Vehicles:

1. Winch cable with a 12,000 pound rating on the first layer of cable;
2. Tow chains of 5/16" alloy or OEM specs, and J.T. hook assembly;
3. Two (2) tow straps rated at 53,000 pounds, minimum;
4. Yellow/amber warning lights with front to rear (360 degree) directional flashing, with on/off switch in cab;
5. Power outlets ("hot boxes"), front mounted , with outlets compatible with 12-volt booster cables;
6. Heavy duty, 60+-amp battery;

7. Two-way radio communications with base office;
8. Cellular telephone;
9. Cab Lighting;
10. Rear work lights;
11. Safety D-ring on rear of truck;
12. Floor jack on rollers with a 2-ton rating;
13. All equipment necessary to operate the motorist assistance vehicles during winter driving conditions (i.e. chains, studded snow tires, etc.);
14. Wrap around push bumpers;
15. Automated Vehicle Location (AVL)
16. Child restraints in accordance with C.R.S. 42-4-236.

B. In addition to the specific vehicle equipment described above, at the start of a shift, the Courtesy Patrol Service vehicles shall contain each of the following items in order to ensure adequate service to disabled vehicles. These items shall be promptly replenished prior to the next shift, and as needed:

Towing Vehicle:

1. Unleaded gasoline (5 gallons) available in an easy access gas transfer system;
2. Safety chains measuring a minimum of 5 ft. (1 each);
3. Radiator water (5 gallons). Anti-freeze shall be added to the water when needed to keep the water in a liquid form;
4. Four way lug wrench (metric) (1 each);
5. Four way lug wrench (standard) (1 each);
6. Rechargeable air bottle (100 psi capacity), hoses and fittings to fit tire valve stems (1 each);
7. Flashlight and spare batteries (1 each);
8. Booster cables, 25 ft. long minimum, 3-gauge copper wire with heavy-duty clamps with one end adapted to truck's power outlets (1 set);
9. Funnel, multipurpose, flexible spout (1 each);
10. 36-inch highly visual orange traffic cones with reflectorized bands (5 each);
11. Reflector vest for the operator (1 each);
12. First aid kit, 16 units (1 kit);
13. Fire extinguisher, 1OABC (1 each);
14. Hand broom (1 each);
15. Snow shovel (1 each);
16. Traction sand (20lbs);
17. Flares, 30 minute (3 each); and
18. Reflective Triangular Warning devices (3 each).

Motorist Assistance Vehicle:

1. Unleaded gasoline (5 gallons) available in an easy access gas transfer system;
2. Safety chains measuring a minimum of 5 ft. (1 each);
3. Radiator water (5 gallons). Anti-freeze shall be added to the water when needed to keep the water in a liquid form;
4. Four way lug wrench (metric) (1 each);
5. Four way lug wrench (standard) (1 each);
6. Toolbox containing:
   Screwdrivers: Standard 1/8, 3/16, ¼, 5/16, (1 each), Phillips head #1 and #2 (1 each), and
   Star Driver (1 set),
   Needle nose pliers (1 pair),
   Adjustable rib joint pliers—2 inch minimum capacity (1 pair),

Adjustable wrenches, 8 inch (1 each) and 12 inch (1 each),
5 pound hammer (1 each)
Rubber mallet (1 each)
Electrical tape (20 yards)
Duct Tape (20 yards)
Tire pressure gauge (1 each)
Mechanic's wire (25 foot roll)
Bolt cutter—24 inch or larger (1 pair), and
Complete set of box wrenches, metric and standard (1 set each).

7. Rechargeable air bottle (100 psi capacity), hoses and fittings to fit tire valve stems (1 each);
8. Flashlight and spare batteries (1 each);
9. Booster cables, 25 ft. long minimum, 3-gauge copper wire with heavy-duty clamps with one end adapted to truck's power outlets (1 set);
10. Funnel, multipurpose, flexible spout (1 each);
11. 36-inch highly visual orange traffic cones with reflectorized bands (5 each);
12. Reflector vest for the operator (1 each);
13. First aid kit, 16 units (1 kit);
14. Drinking water, individually sealed bottles, minimum 16 oz. (12 each);
15. Fire extinguisher, 1OABC (1 each);
16. Hand broom (1 each);
17. Snow shovel (1 each);
18. Traction sand (20lbs);
19. Flares, 30 minute (3 each); and
20. Reflective Triangular Warning devices (3 each).

A. Developer's operators shall wear Department approved uniforms. Uniforms shall include, at a minimum, shirts covering the chest and armpits, full length pants, and protective footwear. Developer shall submit uniform samples for review and Acceptance of the Department prior to beginning work and in the event changes are proposed. The Developers operators shall wear high visibility safety apparel. These items shall be provided and maintained by Developer. Developer's operators shall wear hats with Developer logos at all times while patrolling.

B. Developer's operators shall not smoke during patrol operations and/or while assisting motorists.

C. Developer's operators shall not use, be under the influence of, or have in their possession any alcohol, marijuana, or illegal substances during patrol operations. Operators shall not carry firearms, or any device whose primary function is as a weapon, either on their person or in the towing vehicle.

D. Developer's operators shall express a positive, helpful, cooperative attitude when dealing with motorists.

E. Any new operator assigned by the Developer to the program, shall be properly trained in the courtesy patrol program and field operations. The new operator shall accompany a current operator, experienced with the Mile High Courtesy Patrol, for at least five shifts prior to patrolling a highway.

F. Any new operator assigned by the Developer to the courtesy patrol program shall complete required Developer training, which shall be consistent with training on the Mile High Courtesy Patrol program, prior to patrolling a highway segment.

1.4 GENERAL EQUIPMENT AND OPERATOR REQUIREMENTS:

Developer shall comply with the general equipment and operator requirements described in this section.

Developer shall provide the Courtesy Patrol Service vehicles needed to perform the Departments program patrolling and disabled vehicle assistance services. The Developer shall provide the minimum number of Courtesy Patrol Service vehicles (3) and one backup for the Project. The Courtesy Patrol Service vehicle(s) shall meet the following requirements at all times during the O&M Period During Construction and Operating Period.

A. Tow Trucks:
Tow truck shall be Colorado licensed, including Public Utility Commission licenses, and be an insured Class A tow truck with a minimum gross vehicle rating of 10,000 pounds, dual wheel chassis and four (4) ton recovery equipment rating. Flatbed "roll back" service trucks may be used in-lieu-of boom type wrecker trucks. Flatbed trucks must be equivalent in capacity to specified boom type trucks (excluding vertical lift) to safely handle the scope of work.

B. Motorist Assistance Vehicle:
Motorist assistance vehicles shall be at minimum, a full size, one ton crew cab 4 door, long bed pickup truck with a minimum gross vehicle rating of 10,000 pounds, insured, equipped with and capable of carrying the equipment specified.

C. All Courtesy Patrol Service vehicles shall be completely operational, in sound mechanical condition, and in full compliance with applicable legal requirements at all times, for the performance of the program services.

D. The Courtesy Patrol Service vehicle's exterior shall be reasonably clean at the beginning of each shift, free of road grime, grease, and articles/equipment not needed for the program. No body damage and/or broken glass shall be permitted on the vehicle at the start of a shift.

E. The inside of the vehicle shall be kept clean. The seat and floor shall be free of dirt, grease and any other substance that may transfer to someone's clothing by contact. The seat shall not be torn. Exposed springs, seat stuffing or damaged upholstery shall not be permitted. Torn dashboards, missing screws, hanging hoses or wire, or any other unsightly items inside the cab shall not be permitted.

F. Developer shall maintain a backup Courtesy Patrol Service vehicle at all times, and shall use the backup to replace any disabled or otherwise unavailable Courtesy Patrol Service vehicle.

G. The towing vehicles and motorist assistance vehicles must be a single color, as Accepted by the Department.

H. The vehicle shall display a 15 inch by 26 inch (minimum) Courtesy Patrol logo sign on each door at all times during performance of program services. The Developer shall have signs Accepted by the Department or his/her designee to verify logo and branding consistency. Developer name, phone number, and/or logo shall not be permitted anywhere on the vehicle, unless completely covered with the Courtesy Patrol Service signs during performance of program services. All private information including, but not limited to logos, contact information, etc. shall be completely covered at all times while a vehicle is in service.

I. The Courtesy Patrol Service signs shall be removed from the vehicle at all times when the vehicle is used for purposes other than the Courtesy Patrol Service program. The Developer shall cover or remove future branding/sponsorship information when vehicles are not in service for Courtesy Patrol Service activities.

J. The Developer shall only be required to perform services up to the capacities of their equipment. If situations are encountered outside of their capacities, the operators shall:

1. If on shoulder, offer use of cellular phone.
2. If in roadway, alert motorists by activating yellow warning lights and contacting the responsible law enforcement agency.
3. When a police officer is at the scene, return to patrolling, unless otherwise ordered.
4. When cellular phones are provided, their usage must be reasonable to the situation. Developer shall have the right to control unreasonable requests (such as calls outside the 303, 720, or 719 Area Codes). Developer shall provide the cellular phone numbers to the Department upon request.

1.5 SAFETY OF VEHICLE OCCUPANTS:

Developer shall make provisions to transport all occupants of a disabled vehicle to the shoulder of the road or to the drop-site. Under no circumstances are any occupants or pets to be left unprotected in the disabled vehicle while the vehicle and operator are transported to the shoulder of the road or a Drop Site

1.6 RADIO PROCEDURES:

Department has developed radio procedures required for use by the Developer's operators, and shall provide these procedures to the Developer in writing. The Department may periodically update procedures, updated procedures will be provided to the Developer in writing. A schedule for implementation of the updated procedures will be provided by the Department for the Developer to follow.

Developer shall provide all the radios required for the Courtesy Patrol Services program within the Project

1.7 MAIL IN CARDS:

Developer shall give every assisted motorist a mail-in card, and a program brochure. The card will aid Department in tracking those services provided to the motorist and the public's reaction to the program. Department will provide the Developer with the mail-in cards and program brochures. If mail-in cards and/or brochures are updated, Developer shall distribute the most recent version.

1.8 PAPERWORK:

Developer shall be required to complete an electronic log of each motorist assist and a log of total miles driven each shift for each operator. Motorist assist logs will also include data collection points of detection, verification, lane clearance, and roadway clearance times. Developer's vehicles that are required to use Express Toll Lanes shall also complete a toll log. The logs shall be accurate and completed at the end of each shift. Developer shall submit these logs electronically through the AVL system in chronological order for each operator.

1.9 TRAINING AND OPERATIONAL MEETINGS:

All operators shall receive orientation training provided by the Developer and Accepted by the Department, prior to the operator performing MHCP duties. The Developer shall not allow operators not having this training to perform any duties of the Courtesy Patrol Services program.

Appendix C – I-70 Snow Removal Survey

Appendix C

I-70 Snow Removal Survey

Notification No._____Date _____

Route _____Begin MP_____Interchange? Y N

Part 1 – Traction Control Survey - Sample DURING the storm – at least 2 hours after start of precipitation

Roadway Treatment: Outcome of Sanding & Anti/Deicing

Condition indicator: Presence of traction due to bare pavement from anti/deicing chemical application or presence of sand on an icy surface. Entire highway plus emphasis areas are defined in PD 1055.2 to include bridges, hills, curves and intersections.

Outcome Measurement: Percent (%) of traction on traveled way

☐ Anti/deicer Treatment

☐ Sand Treatment

0	<50% of Emphasis Areas	3	All Emphasis Areas & >50% of Remaining Areas
1	>50% of Emphasis Areas (Curves, Hills, Intersections)	4	Entire Area Bare Due to Deicer or Entire Area Sanded
2	Emphasis Areas Only		

Circle One Only

PART 2 – PRECIPITATION EVENT

Precipitation Start Date

Precipitation Start Time

Precipitation End Date

Precipitation End Time

Bare Pavement Date

Bare Pavement Time

Report time in 24 hour time format

Elapsed Time (Hours)

(note: elapsed time = # of hours between precipitation end date/time and bare pavement. If bare pavement is reached before precipitation end date/time, enter 0)

Schedule 12

HANDBACK REQUIREMENTS

1. General Handback Requirements

Developer shall hand back the Project to the Enterprises on the Expiry Date such that as at the Expiry Date:

a. for each Element, the applicable Target as set out in the Performance and Measurement Table in Appendix A-2 to Schedule 11 (*Operations and Maintenance Requirements*) is met or exceeded;

b. for each Residual Element, the Residual Life at Handback of such Element meets or exceeds its Residual Life Minimum Requirement;

c. for each Element, all Renewal Work identified as needing to be performed in accordance with the most recent Accepted Renewal Work Plan, and following the identification of Category 1 Defects or Category 2 Defects affecting such Element within the 12 months prior to the Expiry Date, has been completed;

d. for each Renewal Element, Developer has demonstrated through the Final Handback Inspection Report that, from the time of its last reconstruction, rehabilitation, restoration, renewal or replacement, such Element has a Useful Life that meets or exceeds its Useful Life Baseline Requirement; and

e. the Project is functional to provide a normal and safe level of service to the traveling public.

2. Specific Handback Requirements

2.1 Bridge Decks

a. The Residual Life Methodology used by Developer for calculating the Residual Life of bridge decks shall, at a minimum, include a prediction of deterioration due to reinforcement corrosion over the duration of the Residual Life Minimum Requirement based on information obtained during the Term, including as reflected in or by:

i. the Durability Plan;

ii. routine inspections;

iii. Renewal Work Plans;

iv. Renewal Work Schedules; and

v. non-routine and Special Inspections.

b. Developer shall ensure that quantitative data used in the prediction of Residual Life for all Residual Elements is representative and is gathered in accordance with the Durability Plan requirements and the relevant inspection requirements.

3. Developer Deliverables and Handback Activities

3.1 Introduction

a. Developer shall submit each of the Handback Deliverables to the Enterprises no later than the date specified in the "End" column against such deliverable in Table 12-1 (*Schedule of Handback Deliverables and Activities*).

b. Table 12-1 below also lists certain activities associated with the preparation of the Handback Deliverables and the required duration of such activities.

Table 12-1 Schedule of Handback Deliverables and Activities

	Months to Expiry Date		
Handback Deliverable/Activity	**Start**	**End**	**Duration (Months)**
Handback Schedule (Deliverable)	-	70	-
Residual Life Methodology (Deliverable)	-	70	-
Enterprises' Review of Handback Schedule and Residual Life Methodology (Activity)	70	68	2
Initial Handback Inspections (Activity)	68	62	6
Preparation of Initial Handback Inspection Report and Asset Condition Report (Activity/Deliverable)	62	60	2
Initial Calculation of Handback Reserve Amount (Deliverable)	60	60	0
Enterprises' Review of Initial Handback Inspection Report, Asset Condition Report and Initial Calculation of Handback Reserve Amount (Activity)	60	58	2
Handback Work Period (Activity)	58	0	58
Second Handback Inspections (Activity)	42	39	3
Preparation of Second Handback Inspection Report and Asset Condition Report (Activity/Deliverable)	39	36	3
Second Calculation of Handback Reserve Amount (Deliverable)	36	36	0
Enterprises' Review of Second Handback Inspection Report, Asset Condition Report and Second Calculation of Handback Reserve Amount (Activity)	36	34	2
Establishment of Handback Reserve Account	36	34	2
Initial Funding of Handback Reserve Account (Activity)	34	34	0
Handback Period (Activity)	34	0	34

Third Handback Inspections (Activity)	20	17	3
Preparation of Third Handback Inspection Report and Asset Condition Report (Activity/Deliverable)	17	14	3
Third Calculation of Handback Reserve Amount (Deliverable)	14	14	0
Enterprises' Review of Third Handback Inspection Report, Asset Condition Report and Third Calculation of Handback Reserve Amount (Activity)	14	12	2
Staff Training (Activity)	9	0	9
Final Handback Inspections (Activity)	3	1	2
Preparation of Final Handback Inspection Report and Asset Condition Report (Activity/Deliverable)	3	1	2
Issuance of Handback Certificate	<1	<1	0
Expiry Date		0	0

3.2 **Handback Schedule**

a. Developer shall prepare, and no later than 70 months prior to the Expiry Date shall submit to the Enterprises for Acceptance, a schedule that complies with the requirements set out in Section 3.2.b of this Schedule 12.

b. The Handback Schedule shall:

i. specify the dates of the activities to be undertaken by Developer for the remainder of the Term in accordance with the requirements of this Schedule 12; and

ii. state the date on which Developer shall provide the Enterprises an updated Maintenance Management Information System in accordance with Schedule 11 (*Operations and Maintenance Requirements*) that takes into account all Handback Inspections to be conducted pursuant to this Schedule 12.

3.3 **General Requirements for Residual Life Methodology**

a. Developer shall prepare, and no later than 70 months prior to the Expiry Date shall submit to the Enterprises for Acceptance, a report that complies with the requirements set out in Section 3.3.b of this Schedule 12.

b. The Residual Life Methodology Report shall:

i. include the evaluation and calculation criteria to be adopted for the calculation of the Residual Life at Handback of each Residual Element;

ii. comply with Good Industry Practice and be in accordance with the Enterprises' and/or CDOT's testing and forecasting methodologies in use in relation to similar Enterprise or CDOT owned or operated assets at the time of preparation of the report;

iii. include the scope of any Residual Life inspections and testing, together with a list of all inspection and testing organizations proposed by, and which shall be financially independent of, Developer; and

iv. address the specific requirements to be included in the Residual Life Methodology Report that are set out in the column headed "Residual Life Methodology (RLM) Requirement" in the table in set out in Appendix A (*Residual Life Requirements*) to this Schedule 12.

Developer shall ensure that all inspection and testing requirements conform to Good Industry Practice and reflect all technological advancements in the field of inspection, testing and Residual Life calculation.

c. In reviewing and commenting on the RLM, the Enterprises shall be allowed access to all of Developer's Project Records used in the preparation of the report.

d. Developer shall be required to obtain the Enterprises' Acceptance of the Residual Life Methodology Report, including the scope and schedule of inspections and tests proposed to be carried out, before commencing any Residual Life inspections and/or tests.

e. Developer shall ensure that the Enterprises are given the opportunity to witness any of the inspections and/or tests and shall provide the Enterprises with a minimum of 15 Working Days' notice prior to the performance of any inspections or tests.

f. Developer shall make full historic records of inspections, monitoring, testing, maintenance and Renewal Work that support the estimates of Residual Life for each Element available to the Enterprises.

3.4 **Qualification of Inspection Engineers and Organizations**

a. The Residual Life Methodology Report shall include the qualifications and experience of all independent engineers, testing facilities, specialists and organizations that shall undertake the Handback Inspections, all of which shall be submitted to the Enterprises for Acceptance in the Residual Life Methodology Report.

b. Developer shall cause:

i. all Handback Inspections to be conducted by a qualified independent consultant appointed by Developer and Accepted by the Enterprises pursuant to Section 3.4.a of this Schedule 12; and

ii. all Handback Inspection Reports and all Residual Life Methodologies to be prepared by an engineer registered in the State of Colorado, who shall be subject to Acceptance by the Enterprises.

3.5 **Asset Condition Report**

a. Developer shall prepare and shall submit (updated as appropriate) to the Enterprises for Acceptance, at the same time as it submits each Handback Inspection Report, a report that complies with the requirements set out in Section 3.5.b of this Schedule 12.

b. Each Asset Condition Report shall provide a record of the asset condition of all Elements of the Project, shall utilize the results of previous inspections and maintenance records held by the MMIS (supported by the results of the Handback Inspections) and, for each Element, shall set out:

i. a description and location of the Element;

ii. information that describes its current condition and rating according to CDOT's inspection manuals in use at the time of inspection, or other agreed inspection methodology;

iii. an assessment of (in the case of Residual Elements) its current Residual Life and (in the case of Renewal Elements) the period remaining of its Useful Life , in either case, based on the Handback Inspections, as well as the Renewal Work Plan inspection, testing and monitoring requirements set out in Schedule 11 (Operations and Maintenance Requirements); and

iv. photographs of the Element to support the assessment of the asset condition.

3.6 **General Requirements for Handback Inspections**

a. Developer shall carry out the inspection and testing detailed in the Handback Schedule and required by the terms of this Schedule 12 for assessing the condition of Elements against intended performance and predicting the time to next maintenance activity and calculated Residual Life.

b. Unless the method of inspection is previously mutually agreed with the Enterprises and then detailed in the Handback Inspection Report, Developer shall conduct all Handback Inspections in accordance with the inspection manuals, guidance, and standards issued by CDOT, and current at the time of inspection, that detail the means and methods for assessing the condition of national highway system assets including road pavement, Structures, cut slopes and embankments and other ancillary assets such as signs, fences, barriers and lighting stock.

3.7 **Initial Handback Inspections**

a. Developer shall carry out the initial Handback Inspections to identify and establish the asset condition, Residual Life and period remaining of the Useful Life of all Elements and verify the extent of all Work required to ensure that the requirements set out in Section 1 of this Schedule 12 are satisfied as at the Expiry Date (the "Handback Work").

b. The inspection schedule shall be coordinated with the Enterprises and shall take account of the Enterprises' requirements for joint inspections, provided that, in any event, Developer shall provide the Enterprises a minimum of 15 Working Days' notice of any proposed inspection.

c. Developer shall carry out the initial Handback Inspections from 68 to 62 months prior to the Expiry Date.

d. Developer shall undertake appropriate testing to determine the condition of Elements, in accordance with the requirements set out in the column headed "Inspection Requirements" set out in Appendix A (*Residual Life Requirements*) to this Schedule 12. The required testing shall be identified based on the results of the inspections in order to permit an assessment of the performance and progressive deterioration of each Element over the Term. The testing shall be conducted under the control of an independent consultant appointed by the Developer who shall be subject to Acceptance by the Enterprises.

3.8 **Initial Handback Inspection Report**

a. Following the initial Handback Inspection(s) and testing, Developer shall prepare, and no later than 60 months prior to the Expiry Date submit to the Enterprises for Acceptance, a report that complies with the requirements set out in Section 3.8.b of this Schedule 12.

b. The Initial Handback Inspection Report shall, at a minimum, include the following information:

i. initial Handback Inspection(s) results;

ii. results of the Asset Condition Report for all Elements;

iii. a list of each Residual Element that Developer considers:

A. did meet or exceed the applicable Target as set out in the Performance and Measurement Table in Appendix A-2 to Schedule 11 (*Operations and Maintenance Requirements*) at the time of the inspection;

B. would meet or exceed the applicable Target as set out in the Performance and Measurement Table in Appendix A-2 to Schedule 11 (*Operations and Maintenance Requirements*) as at the Expiry Date without the need for Handback Work; and

C. its Residual Life at Handback would meet or exceed its Residual Life Minimum Requirement without the need for Handback Work;

iv. a list of each Residual Element that Developer considers:

A. did not meet or exceed the applicable Target as set out in the Performance and Measurement Table in Appendix A-2 to Schedule 11 (*Operations and Maintenance Requirements*) at the time of the inspection and will require Handback Work prior to the Expiry Date to ensure that (i) it would meet or exceed such Target at the Expiry Date and (ii) its Residual Life at Handback would meet or exceed its Residual Life Minimum Requirement; and

B. did meet or exceed the applicable Target as set out in the Performance and Measurement Table in Appendix A-2 to Schedule 11 (*Operations and Maintenance Requirements*) at the time of the inspection, but will require Handback Work prior to the Expiry Date to ensure that (i) it would meet or exceed such Target at the Expiry Date and (ii) its Residual Life at Handback would meet or exceed its Residual Life Minimum Requirement; and

v. a schedule (the "Handback Work Schedule") providing details of all Handback Work required, the timing and implementation strategy for the Handback Work and an estimate of the Handback Reserve Amount .

c. In reviewing the report, the Enterprises shall be allowed access to all of Developer's Project Records used in the preparation of the report.

3.9 **Handback Work Obligation**

a. Developer shall carry out the Handback Work in accordance with the Handback Work Schedule set out in the Accepted Initial Handback Inspection Report and each subsequent Accepted Handback Inspection Report.

b. Handback Work identified as required in the Initial Handback Inspection Report and each subsequent Accepted Handback Inspection Report for any Residual Element to meet or exceed its Residual Life Minimum Requirement shall be completed no later than 18 months before the Expiry Date. All other Handback Work shall be completed before the Expiry Date.

c. During the Handback Work Period Developer shall ensure that all Elements meet or exceed the Performance Requirements specified for the relevant Element in Appendix A-2 to Schedule 11 (*Operations and Maintenance Requirements*).

d. During the Handback Work Period the Annual O&M Report shall detail the results of the Asset Condition Inspections, Specialist Inspections and Handback Work carried out during the previous year.

3.10 **Second and Third Handback Inspections**

a. The objective of the second and third Handback Inspection(s) shall be to update the Asset Condition Report of each Element and to record wherever actions have been taken such as repairs, Renewal Work and/or Handback Work to address the findings of the previous Handback Inspection Report.

b. The inspection schedule shall be coordinated with the Enterprises and shall take account of CDOT's requirements for joint inspections, provided that, in any event, Developer shall provide the Enterprises a minimum of 15 Working Days' notice of any proposed inspection.

c. Developer shall carry out:

i. the second Handback Inspection(s) from 42 to 39 months prior to the Expiry Date; and

ii. the third Handback Inspection(s) from 20 to 17 months prior to the Expiry Date.

3.11 **Second and Third Handback Inspection Reports**

a. Following:

i. the second Handback Inspections, Developer shall prepare and, no later than 36 months prior to the Expiry Date; and

ii. the third Handback Inspections, Developer shall prepare and, no later than 14 months prior to the Expiry Date,

in each case submit to the Enterprises for Acceptance, a report that complies with the requirements set out in Section 3.11.b of this Section 12.

b. The Second Handback Inspection Report and the Third Handback Inspection Report shall, at a minimum, include the following information:

i. results of the relevant Handback Inspection(s);

ii. list of repairs, Renewal Work and Handback Work undertaken subsequent to the previous Handback Inspection(s);

iii. revised Asset Condition Report for all Elements; and

iv. revised Handback Work Schedule.

c. In reviewing the report, the Enterprises shall be allowed access to all of Developer's Project Records used in the preparation of the report.

3.12 **Final Handback Inspection Report**

a. Three months prior to the Expiry Date, Developer and the Enterprises shall jointly carry out the final Handback Inspections.

b. Developer shall prepare, and no later than one month prior to the Expiry Date submit to the Enterprises for Acceptance, a report that complies with the requirements set out in Section 3.12.c of this Schedule 12.

c. The Final Handback Inspection Report shall include the final Asset Condition Report of all Elements of the Project and a list of all Elements and their Residual Life or Useful Life and shall demonstrate effective completion of all Handback Work identified in the Initial Handback Inspection Report, the Second Handback Inspection Report and the Third Handback Inspection Report.

d. Following the Enterprises' Acceptance of the Final Handback Inspection Report, they shall, in their discretion, issue a certificate to Developer certifying either:

i. that all Handback Requirements have been met; or

ii. that some, but not all, of the Handback Requirements have been met and any such certificate shall specify which Handback Requirements the Enterprises consider have not been met.

Any certificate issued pursuant to this Section 3.12.d is a "Handback Certificate".

3.13 **Staff Training**

No later than nine months prior to the Expiry Date, Developer shall make arrangements to provide training for the Enterprises' and CDOT's nominated employees, or any other persons designated by the Enterprises, pertaining to all the aspects of the operation and maintenance of the Project to facilitate a seamless handover.

4. Handback Reserve Account

4.1 **Establishment and Security**

a. No later than two months prior to the first day of the Handback Period, Developer shall establish an interest-bearing bank account (the "Handback Reserve Account"), with a financial institution to be selected by the Enterprises in their discretion, in the joint names of Developer and the Enterprises (or, at their discretion, either of them). Promptly after establishing the Handback Reserve Account, Developer shall provide to the Enterprises all details regarding the Handback Reserve Account, including the name, address and contact information for the institution and the account number.

b. The Parties agree that (i) withdrawals from the Handback Reserve Account will only be permitted in accordance with this Section 4 and (ii) any withdrawal from the Handback Reserve Account will require the prior written approval of all named account holders

(which approval each account holder shall be required to provide if the proposed withdrawal is in accordance with this Section 4).

c. At the discretion of the Enterprises, the Handback Reserve Account, and withdrawals therefrom, shall be controlled by a third party escrow agent pursuant to the terms of an escrow agreement to be entered into by such agent and the Parties. If the Enterprises exercise their discretion pursuant to this Section 4.1.c, the identity of such agent, and the terms of such agreement, shall be agreed between the Parties, acting reasonably.

d. Developer shall not be permitted to grant any Encumbrance in favor of any third party (including, for certainty, its Lenders) in relation to the Handback Reserve Account or any amounts standing to the credit of it.

4.2 **Reserve Funding**

a. No later than:

i. two months prior to the commencement of the Handback Work Period;

ii. two months prior to the commencement of the Handback Period; and

iii. 14 months prior to the Expiry Date,

Developer shall deliver to the Enterprises a report setting out its calculations of the Handback Reserve Amount in accordance with Section 4.3 of this Section 12, together with the report of an independent consultant selected by Developer, with the Acceptance of the Enterprises, either verifying that the Developer's calculations of the Handback Reserve Amount are consistent with the then most recent Handback Work Schedule or stating the consultant's determination of the Handback Reserve Amount. Such reports shall be addressed to the Enterprises and shall state explicitly that the Enterprises may rely on the report. Within 45 Calendar Days of any such report being delivered to the Enterprises, the Parties shall seek to agree (acting reasonably) upon the Handback Reserve Amount and, in the absence of agreement within such period, the Handback Reserve Amount shall be the amount equal to (i) the amount specified in the independent consultant's report plus (ii) 50% of the amount by which the Enterprises' determination of the Handback Reserve Amount exceeds the amount specified in the independent consultant's report.

b. Subject to Section 4.5 of this Schedule 12, no later than five Working Days:

i. prior to the commencement of the Handback Period, Developer shall be required to fund the Handback Reserve Account in the amount of the Handback Reserve Amount determined in accordance with Section 4.2.a of this Schedule 12;

ii. after determination of the Handback Reserve Amount in accordance with Section 4.2.a of this Schedule 12 following submission of a report in accordance with Section 4.2.a.iii of this Schedule 12, Developer shall be required to ensure

that the Handback Reserve Account is funded in an amount at least equal to the Handback Reserve Amount, provided that, to the extent that the amount standing to the credit thereof at such time exceeds the Handback Reserve Amount, the Developer shall be entitled to have such excess amount withdrawn and paid to it.

c. Unless Developer has provided a Handback Letter of Credit that complies with the requirements of Section 4.5 of this Schedule 12, to the extent that at any time after the commencement of the Handback Period the balance standing to the credit of the Handback Reserve Account is not at least equal to the Handback Reserve Amount, the Enterprises shall, until such time as the balance standing to the credit of the Handback Reserve Account is equal to the Handback Reserve Amount, make deductions from subsequent Performance Payments, and pay such amounts into the Handback Reserve Account.

4.3 **Calculation of Handback Reserve Amount**

The following methodology shall be used for calculating the Handback Reserve Amount.

a. The "Handback Renewal Elements Amount" means the aggregate amount, which shall be calculated by an independent evaluator hired by Developer at its own cost and expense, Accepted by the Enterprises and who shall owe a duty of care to the Enterprises, of the estimated cost (in real dollars) to renew or replace each Renewal Element at the end of its Useful Life multiplied by a fraction (the "Deterioration Fraction", the numerator of which is its Age and the denominator of which is its Useful Life). In such calculation:

i. the Handback Renewal Elements Amount shall not be less than zero;

ii. the value of the Deterioration Fraction shall not be greater than 1.0; and

iii. where a Renewal Element has not been renewed or replaced during the Term, the value of the Deterioration Fraction for such Element shall be 1.0.

b. The "Handback Residual Elements Amount" means the aggregate amount, which shall be calculated by an independent evaluator hired by Developer at its own cost and expense, Accepted by the Enterprises and who shall owe a duty of care to the Enterprises, of the estimated cost (in real dollars) to improve, repair, renew or replace each Residual Element to ensure that its measured Residual Life will meet or exceed its Residual Life Minimum Requirement.

c. Where the Age, Useful Life or Residual Life of any Element varies across the Project, the calculations of the Handback Renewal Elements Amount and the Handback Residual Elements Amount shall take into account such variability through multiple calculation line items for each Element, each line item calculating the Handback Reserve Amount for component parts of the Element having similar Age, Useful Life or Residual Life as appropriate. The calculations of the Handback Renewal Elements Amount and the

Handback Residual Elements Amount shall be made using the values of Age, Useful Life, Residual Life and estimated costs applicable as of the date of each calculation.

d. For purposes of calculating the Handback Reserve Amount, the estimated costs of performing the Handback Work shall be equal to the greater of (i) the cost to Developer of self-performing the Handback Work and (ii) the cost to Developer of procuring the performance of the Handback Work by one or more third parties on an arms-length and commercially reasonable basis, in the case of (i) and (ii), inclusive of all design, engineering, construction, QA/QC, overhead, profit, insurance, bonding, escalation and other costs to perform such Handback Work in full.

4.4 **Handback Reserve Account Use**

a. Developer shall not be entitled to withdraw funds from the Handback Reserve Account to pay for the cost of performing any Handback Work.

b. The Handback Reserve Account shall remain in place and (subject to Section 4.5 of this Schedule 12) be fully funded at all times in an amount at least equal to the Handback Reserve Amount until the issuance of a Handback Certificate by the Enterprises or, if earlier, the Termination Date.

c. Promptly following the issuance of a Handback Certificate by the Enterprises (or, if earlier, the Termination Date), any amounts standing to the credit of the Handback Reserve Account shall be withdrawn therefrom in the following order of priority:

i. first, an amount equal to the portion of the Handback Reserve Amount equal to the cost of performing the Handback Work not performed by Developer in relation to any Handback Requirements specified in the Handback Certificate as not having been met, shall be paid to the Enterprises; and

ii. second, if Section 4.4.c.i. of this Section 12 applies, the remaining balance (or, if the Handback Certificate certified that all Handback Requirements had been met, the full balance) standing to the credit of the Handback Reserve Account shall be paid to the Developer,

provided that, if the Termination Date occurs prior to the issuance of a Handback Certificate, the full balance standing to the credit of the Handback Reserve Account as at the Termination Date shall be paid to the Enterprises.

d. Any interest that accrues on amounts standing to the credit of the Handback Reserve Account shall only be withdrawn at the times other amounts are being withdrawn therefrom in accordance with, and shall be withdrawn pursuant to, Sections 4.2.b.ii and 4.4.c of this Schedule 12.

4.5 **Handback Letter of Credit**

a. Instead of funding the Handback Reserve Account, Developer may, at its discretion, deliver to the Enterprises one or more letters of credit (collectively, the "Handback Letter of Credit") from an Eligible Financial Institution, each in a form Acceptable to the Enterprises and on the basis that the Enterprises shall be the sole beneficiaries, with aggregate value equal to the Handback Reserve Amount (provided that, for certainty, notwithstanding such delivery by Developer, it shall in any event be required to establish (but not fund) the Handback Reserve Account in accordance with the requirements of Section 4.1 of this Schedule 12).

b. The Enterprises shall have the right to draw on the Handback Letter of Credit:

i. in circumstances where, had Developer not elected to deliver a Handback Letter of Credit pursuant to this Section 4.5, the Enterprises would have been entitled to payment of a portion of the amounts standing to the credit of the Handback Reserve Account pursuant to Section 4.4.c.i of this Schedule 12, up to an amount equal to such portion;

ii. if the issuer of the Handback Letter of Credit ceases to be an Eligible Financial Institution, up to the full amount of the Handback Letter of Credit, provided that, following such a draw, the Enterprises shall pay such amount into the Handback Reserve Account and the provisions of Sections 4.1, 4.2 and 4.4 of this Schedule 12 shall apply thereafter to the operation of the Handback Reserve Account; or

iii. if the Termination Date occurs prior to the issuance of a Handback Certificate, up to the full amount of the Handback Letter of Credit.

5. Deliverables

Deliverables shall be submitted for Acceptance in accordance with the specified time frames in both electronic format and hardcopy format. Acceptable electronic formats include Microsoft Word, Microsoft Excel, or Adobe Acrobat (PDF) files, unless otherwise indicated.

Deliverable	Information, Acceptance or Approval	Schedule
Handback Schedule	Acceptance	70 months before the Expiry Date
Residual Life Methodology Report	Acceptance	70 months before the Expiry Date
Asset Condition Report	Acceptance	Submit with all Handback Inspection Reports
Handback Work Schedule	Acceptance	Submit with all Handback Inspection Reports
Initial Handback Inspection Report	Acceptance	60 months before the Expiry Date

Deliverable	Information, Acceptance or Approval	Schedule
Initial Calculation of Handback Reserve	Acceptance	60 months before the Expiry Date
Second Handback Inspection Report	Acceptance	36 months before the Expiry Date
Second Calculation of Handback	Acceptance	36 months before the Expiry Date
Third Handback Inspection Report	Acceptance	14 months before the Expiry Date
Third Calculation of Handback Reserve	Acceptance	14 months before the Expiry Date
Final Handback Inspection Report	Acceptance	After final Handback Inspections

Appendix A
Residual Life Requirements

Element	Residual Life at Handback (yrs)	Inspection Requirements	Residual Life Methodology (RLM) Requirement
Road Pavement			
Traveled way – structural capacity	10	Pavement inspections shall be undertaken by an independent consultant jointly approved by the Enterprises and Developer. Inspections shall provide a continuous or near-continuous record of Residual Life in each lane. Where the inspection method does not provide a continuous record of Residual Life, the number of valid measurements in each measurement section shall be sufficient to give a statistically valid result. Inspections shall be repeatable to an agreed level of accuracy and inspection contracts shall include an agreed proportion of inspections to verify accuracy. Inspections shall include automated condition distress survey, ride quality, skid resistance, rutting and faulting and measurement of structural capacity of the pavement.	RLM shall: • Be capable of calculation of Residual Life for any 0.1 mile section. • Take account of the thickness and stiffness of the pavement layers, the pavement loading history in equivalent standard axles as calculated from the traffic volume reports and the forecast traffic volumes, measured in equivalent standard axles, for the following 15 years. At the Expiry Date, the structural capacity of each lane of the mainline roadway shall be such that a rehabilitation design for 10 years of traffic loading starting as of the Expiry Date will require no more than a 2-inch asphalt concrete overlay or equivalent treatment for the pavement type. The calculation method may assume that the 2 inch overlay is applied at any time over the ten years following the Expiry Date. The 10 year traffic loading will be determined based on the average annual traffic measured over the four years prior to the date upon which the calculation is undertaken and shall not include any predicted traffic escalation. Pavement strength testing and subsequent analysis to determine the structural capacity and the rehabilitation needed to meet the requirement above

Appendix A
Residual Life Requirements

Element	Residual Life at Handback (yrs)	Inspection Requirements	Residual Life Methodology (RLM) Requirement
			shall be completed by an independent consultant acceptable to both the Enterprises and Developer. Developer shall provide all traffic accommodation to allow pavement strength testing or other testing (either destructive or non-destructive), as required.
Structures			
Reinforced concrete	40	Inspections of Structures shall be undertaken by independent testing organizations. Inspections shall follow the latest inspection guidelines (as they apply at the relevant date that the testing is undertaken) recognized by the Enterprises. A close examination shall be made of all parts of each Structure. Non-destructive tests shall be undertaken appropriate to the type of Structure. These shall include the measurement of structural deflection under calibrated load, the measurement of chloride and carbonation profiles from surface to reinforcement and/or tendon level, half-cell potential and the in-situ strength testing of concrete elements. Testing of steel Structures shall include the depth of corrosion and/or the measurement of remaining structural thickness for hidden	RLM shall: • Draw on historical asset maintenance records, inspection and test histories for each Structure. Take account of the Enterprises', CDOT's and FHWA records of other Structures on the network with similar characteristics. • Include an assessment of load carrying capacity based on the original structural design calculations, the as built drawings, loading history and results of load deflection tests where appropriate. • Take account of any trends in asset deterioration to determine the rate of deterioration and to predict the future condition of individual Elements and the entire Structure. • Take account of industry guidance relating to residual life estimation. The measured performance shall be compared with expected performance and trends in asset deterioration and maintenance to predict the future condition and maintenance requirements of main
Pre-stressed concrete	40		
Structural steelwork	40		
Weathering steel	40		
Corrugated steel	40		

Appendix A
Residual Life Requirements

Element	Residual Life at Handback (yrs)	Inspection Requirements	Residual Life Methodology (RLM) Requirement
		and exposed parts. All lengths of weld shall be tested for cracking at key areas of structural steelwork.	structural Elements.
Bridge Deck (Structural)	15	Inspections shall be in accordance with the Durability Plan schedule. Inspections shall, at a minimum, identify and measure de-lamination in Bridge decks by chain dragging or hammer sounding, the measurement of chloride and carbonation profiles from surface to reinforcement and/or tendon level, half-cell potential and the in-situ strength testing of concrete elements.	As above
Railing	25	Inspections of Structures shall be undertaken by independent engineers, test facilities and specialists. For visual inspections and measurement, competence shall be based on experience and training. For Specialist Inspections, competence shall be based on the possession of valid national or international certification by a recognized certification authority. Inspections shall follow the latest inspection guidelines (at	RLM shall: • Draw on historical asset maintenance records, inspection and test histories for each Structure. • Take account of the Enterprises', CDOT's and FHWA records of other Structures on the network with similar characteristics.
Bearings	25		
Overhead sign supports (structural Elements)	15		

Appendix A
Residual Life Requirements

Element	Residual Life at Handback (yrs)	Inspection Requirements	Residual Life Methodology (RLM) Requirement
Retaining walls (Including MSE Walls)	40	the time of inspection) issued by the Enterprises. A close visual inspection shall be made of all parts of each Structure including items such as hidden or limited access components such as cables, bearings and expansion joints.	
Drainage			
Underground storm sewer systems (Including pipes, manholes, chambers.)	40	Inspection of storm sewer systems shall include closed circuit TV inspection of all buried pipe work. Groundwater level monitoring at locations defined in the Residual Life Methodology Report shall be required to provide assurance of a 10 year Residual Life for groundwater interceptor drains. Inspection of stormwater management systems shall include all components such as ditches, stormwater basins and filters. Inspections of culverts shall include measurement of deformation.	RLM shall: • Draw on historical asset maintenance records, inspection and test histories for each Element of the drainage system. • Include a methodology to determine the Residual Life of filter drains designed to intercept groundwater.
Culverts/ headwalls	40		
Reinforced ditches (Concrete lined, rock channel, tied concrete block, energy dissipaters.)	10		
Underdrains, filter drains	10		
End Treatments (inlet protection, aprons)	25		

Appendix A
Residual Life Requirements

Element	Residual Life at Handback (yrs)	Inspection Requirements	Residual Life Methodology (RLM) Requirement
Earthworks			
Earthwork slopes (Including reinforced soil slopes)	50	For embankment and cut slopes a risk based inspection procedure shall be adopted following Good Industry Practice. Deformation monitoring will be required to provide assurance through the RLM of a 50-year Residual Life. Inspections of all ancillary items shall be undertaken by personnel having adequate training on modes of failure, risk assessment and observational skills.	RLM for earthwork slopes shall draw on historical inspection and asset maintenance records and the vulnerability of the slope to failure.
Ancillaries			
Concrete barrier (median)	25	Inspections of all ancillary items shall be undertaken by personnel having adequate training on modes of failure, risk assessment and observational skills where applicable elements will be rated to ensure adequate performance and load resistance. Unless otherwise agreed inspections to be carried out in accordance with guidance, manuals and standards issued by the Enterprises current at the time of inspection.	RLM shall draw on historical inspection, maintenance and rehabilitation records for system components, and life cycle and durability analyses.
Fences	10		
Light Poles	10		
Curbs and gutters	10		
Manhole covers, gratings, frames and boxes	20		

Appendix A
Residual Life Requirements

Element	Residual Life at Handback (yrs)	Inspection Requirements	Residual Life Methodology (RLM) Requirement
Mechanical and Electrical Systems			
Cabling, joints, switch gear, etc.	20	Inspection scope and depth shall be determined by the inspecting organization but as a minimum shall be based upon relevant State or Federal codified requirements, applicable NFPA Standards, and by the design and system manufacturer's/fabricators inspection requirements.	RLM shall draw on historical inspection, maintenance and rehabilitation records for system components, and life cycle and durability analyses.
Cover Plumbing Systems			
Standpipe and Sprinkler/Deluge Piping and nozzles	50	Inspections shall be based upon Good Industry Practice, manufacturers' inspection requirements and applicable FHWA requirements and NFPA Standards. Inspection of electrical systems shall be undertaken by qualified individuals (NETA or equivalent for electrical, NICET for Fire Alarm, other) and performed in accordance with NFPA 70B, as a minimum.	RLM shall draw on historical inspection, maintenance and rehabilitation records for system components, and life cycle and durability analyses and historical fault logs from the SCADA system
Roadway Piping and Drains	50		
ITS/Tolling Equipment			
ITS and Tolling Civil Infrastructure (conduits, conductors, cables and pull boxes, cabinets and foundations)	20	Inspections shall be based upon Good Industry Practice, manufacturers' inspection requirements and Applicable Standards.	RLM shall be based on the manufacturer's or supplier's recommended component life together with records of performance from Developer including historical inspection, maintenance and rehabilitation records for system components, and life cycle and durability analyses

Appendix B
Useful Life Baseline Requirements

Element	Useful Life (yrs)
Road Pavement	
Traveled way – surfacing including ramps	10
Structures	
Corrosion protection for structural steelwork	30
Bridge wearing surface	20
Deck joints	20
Cover MEP Systems	10
Roadside Ancillaries	
Metal beam guard rail	20
Impact attenuators	20
Overhead sign panels	10
Lighting luminaries and regulators	8
Roadside traffic sign panels	10
Pavement markings	2
Delineators	4

Schedule 13
Required Insurances

[*To be provided in a subsequent Addendum*]

Schedule 14
Strategic Communications

1. GENERAL

1.1 General Requirements

1.1.1 Providing timely, relevant and context sensitive information is a critical component of the Project. The Developer and the Department shall work collaboratively to provide a robust and coordinated communications approach to achieve the overall Strategic Communication goals. The Developer shall be responsible for development and implementation of a communication strategy in accordance with the requirements of this Schedule. The Developer shall document these communication strategies in an overall Strategic Communications Plan, which shall comprise the individual plans required within this Schedule.

1.1.2 The Strategic Communications Plan shall address the following issues:

a. Communication and outreach commitments made in the I-70 East EIS;

b. Presence of an environmental justice community and limited English proficient residents and business owners in close proximity to project;

c. Community “fatigue” from lengthy I-70 East EIS;

d. Diversity of stakeholders, including local residents, local governments, commuters, small and local businesses, and major national/international corporations;

e. Additional infrastructure projects planned near the Project area; and

f. Use of a public-private partnership to deliver this Project.

2. STAFF REQUIREMENTS

2.1 General Requirements

2.1.1 The Developer shall provide a full-time Project Communications Manager (PCM) with at least seven years’ professional experience working on design-build construction projects and a practical understanding of construction schedules, Transportation Management Plans (TMPs), and Work performance processes; experience with and understanding of the importance of maintaining good relationships between the Project and government, businesses, residents, the general public, and other stakeholders; and experience with implementing communication and Public Involvement (PI) strategies on projects of similar scope, nature, and complexity as this Project. The PCM shall be responsible for overseeing all Developer communications efforts during the Term.

2.1.2 The Developer shall provide a Spanish/English bilingual Community Liaison with experience in and knowledge of the Swansea-Elyria neighborhoods. The Community Liaison shall coordinate closely with the Department and be responsible for ensuring that local residents, businesses and nonprofit groups are informed about the Project and have a single point of contact for all questions and concerns.

2.1.3 The communications team shall be housed at the Developer’s office during the Construction Period and with the Developer’s Operations team during the remainder of the Term.

3. STAFF COORDINATION

3.1 General Requirements

3.1.1 The Developer shall hold weekly Strategic Communication meetings at the Project office. At the meetings the Developer will discuss weekly communications issues and provide details for upcoming media advisories/press releases, Lane Closure Reports, website updates and information line recordings. The Developer shall submit the names and resumes of all members

of the communications team with assigned roles and responsibilities and provide a staff availability list covering all days and hours during the Construction Period.

3.1.2 Public Involvement Services Contact Sheet

The Developer shall prepare a PI Contact Sheet containing the names of appropriate Strategic Communications personnel for the Project. At a minimum, the contact list shall include the name, address, phone number(s) and email addresses for the following individuals:

a. Department;
   i. Project Director;
   ii. Project Communications Manager;
   iii. Project website administrator;
   iv. Community Liaison; and
   v. Project Colorado Transportation Management Center (CTMC) contact.

b. City and County of Denver;
   i. City Manager's Office;
   ii. Public Works;
   iii. PI Office;
   iv. Chamber of Commerce;
   v. Fire/rescue; and
   vi. Police department.

c. City of Aurora;
   i. City Manager's Office;
   ii. Public Works;
   iii. PI Office;
   iv. Chamber of Commerce;
   v. Fire/rescue; and
   vi. Police department.

d. City of Commerce City;
   i. City Manager's Office;
   ii. Public Works;
   iii. Public Information Office (PIO);
   iv. Chamber of Commerce;
   v. Fire/Rescue; and
   vi. Police Department.

e. Local State Patrol Office;

f. Local hospitals;

g. Key stakeholders: to be provided by the Department, including by not limited to the following:
   i. School/school district;

ii. Businesses;

iii. Community centers;

iv. Churches; and

v. Neighborhood associations.

h. Visitor/tourist destinations;

i. Railroads

j. Special districts (Business improvement, parks, maintenance, water, etc.);

k. Airports;

l. Utility Owners;

m. Commercial vehicle operators; and

n. Others as defined by the Department.

4. STRATEGIC COMMUNICATIONS PLANS

4.1 General Requirements

4.1.1 The Developer shall prepare and maintain an overall Strategic Communications Plan consisting of the following individual plans to ensure well-coordinated two-way communications during each phase of the project as listed below:

a. Construction Work Communications Plan (CWCP);

b. Maintenance and Operations Communications Plan (MOCP); and

c. Crisis Communications Plan (CCP).

4.1.2 Each plan shall include planned communications strategies; primary stakeholder communications lists; and identification of any PI issues and proposed outreach. Each plan shall be submitted to the Department for Approval according to the timelines provided in this Schedule. The Developer shall monitor and improve the effectiveness of each plan and resubmit for Approval annually upon the anniversary of the initial Approval by the Department or whenever the following conditions exist:

a. A plan or procedure no longer adequately addresses the matters it was originally intended to address;

b. A plan or procedure does not conform to the requirements of this Agreement;

c. An audit by the Developer or the Department identifies a deficiency requiring an update; or

d. Organizational structure changes require revision to a plan.

4.1.3 The Developer shall clearly identify in a cover sheet what changes were made in each update to expedite the Department's review. Also, a red line and a final copy shall be provided.

4.1.4 Each plan shall describe the basic roles and responsibilities between the Department and the Developer. In general:

a. Department Responsibilities

The Department is responsible for communicating overall vision on the Project including why the Project is needed, what Work will be done, how the Project will benefit customers, how the Project fits into the community, and how the Project fits into broader transportation plans.

i. The Department will communicate information regarding the Project vision, benefits, and budget.

ii. The Department will communicate the overall purpose and implementation of the Express Lanes.

b. Developer Responsibilities

The Developer is responsible for communicating overall coping information during Construction Work including details about the TMP, and other Activities that affect residents and businesses. This includes communications during the Construction Work and O&M Work phases of the Project.

c. Joint Department/Developer Responsibilities

The Developer shall work with the Department to develop key messages related to Construction Work and O&M Work activities. The Department will have final Approval before the messages are disseminated.

i. Government Relations

Throughout the Construction Work, all communication requests received by the Developer from Governmental Authorities shall be immediately referred to the Department (not including those requests related to Project management or coordination for Local Agency Permits, or related to the Developer's responsibilities under this Agreement). The Developer shall assist in giving timely information to the Department regarding construction Activities, and shall participate in meetings as requested.

ii. Media Requests

The Developer shall make project managers, supervisors, and other area experts available to the Department for assistance in media requests. The Developer shall also assist in media site visits and adhere to media deadlines when possible.

5. CONSTRUCTION WORK COMMUNICATIONS PLAN

5.1 General Requirements

5.1.1 The Developer shall prepare and maintain a CWCP to develop two-way communication of Project information with the public. This CWCP shall be used by the Developer throughout the duration of the Construction Period to manage and implement the PI process. The Developer's CWCP shall be submitted to the Department for Approval prior to the issuance of NTP 1.

5.1.2 The CWCP shall include the following:

a. Stakeholders and Key Communication Topics

The Developer shall use a variety of strategic PI approaches and tools to ensure that stakeholders have accurate Information about the Project schedule, progress and construction information, as well as address issues as they arise.

b. Community, Government and Business Stakeholders

The Developer shall develop and implement community and business relations strategies that communicate coping messages to the public. Coping messages 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 Construction Work with as little disruption as possible. When necessary, PI strategies shall be tailored to individual stakeholders and shall specify which approaches and tools will be used to disseminate information. Specific organizations shall be provided by the Department utilizing the database established through the I-70 East EIS. Project stakeholders include, but are not limited to, the following groups:

i. Area residents;

ii. Local and regional business owners, employees and customers;

iii. Neighborhood associations;

iv. Local community organizations;

v. Local schools;

vi. Property owners and property management companies;

vii. Commuters;

viii. Transportation management/advocacy organizations;

ix. Denver International Airport;

x. Regional Transportation District (RTD);

xi. Traveling public;

xii. Local, regional, and state government officials;

xiii. Delivery and courier services;

xiv. Taxis, shuttles, and rental car companies;

xv. Commercial vehicle operators, Ports of Entry and Denver Permit Office, and Colorado Motor Carriers Association;

xvi. Emergency response agencies, such as the Colorado State Highway Patrol, and the local police departments, sheriff departments, fire departments, ambulance service providers, and hospitals;

xvii. Tourist destinations and organizations;

xviii. Colorado Department of Transportation (CDOT) employees and other internal team members, including CDOT Headquarters, the Office of Communications and the Government Relations Office;

xix. Disadvantaged Business Enterprise companies;

xx. Utility owners; and

xxi. Railroads.

c. Key Communication Topics

i. The CWCP shall describe outreach strategies specific to the following topics:

A. Environmental Information

(1) The CWCP shall identify a plan for coordinating any environmental mitigation requirements as provided in Schedule 17 Environmental Requirements, as they pertain to the public, to ensure the public is aware of and participates in those areas where their input is required.

(2) The Developer shall make the Environmental Compliance Work Plan (ECWP) monthly update as provided in Schedule 17 Environmental Requirements available to the public via the Project website on a monthly basis. The Developer shall make the results of all PM10 monitors, as specified in Schedule 17 Environmental Requirements, available on the Project website on a continuous basis.

B. Noise

The CWCP shall identify a plan for communicating the scheduling of high noise events as well as temporary and permanent noise wall construction with individual property owners and impacted communities.

C. Access to Local Schools

The CWCP shall identify a plan for coordinating with Denver Public Schools, Swansea Elementary School, Garden Place Elementary, and Bruce Randolph Middle School to maintain bus and vehicle access during the Construction Period.

D. Access to Transit and Pedestrian and Bicycle Routes

The CWCP shall identify a plan for communicating to the public and other associated stakeholders significant impacts and routing changes pertaining to mass transit, bicycles, pedestrian and handicap mobility.

5.2 Public Information Outreach Tools

The Developer shall provide a PI tool box with the flexibility to meet different stakeholder needs. The Developer shall continue to coordinate with the Department to ensure that the tools employed during the Project are effective. All PI materials shall be provided in English and Spanish, at the discretion of the Department.

a. Hotline

i. The Developer shall establish a PI office equipped with a telephone, voicemail, computer and email address. The PI telephone line shall be a local call line. The voicemail greeting for the project information line shall be recorded in English and Spanish and provide an updated message each week, or each day if necessary, concerning the Project's completion date and forthcoming activities on the Project and allow the recording of a message from the caller. If unable to answer the PI line, the Developer shall check and respond to voicemail messages throughout each day that construction operations and lane Closures are being carried out. The Developer shall track inquiries made by citizens and businesses, including names, addresses, phone numbers, and subsequent action taken during construction; these customer inquiries and follow-up action shall be entered into Dialog, a web-based contact and issue tracking database provided by the Department. The Developer shall pay for a Dialog license. The system shall provide an automated report to the Department each week. All inquiries and complaints shall be followed up with a return phone call or email from either the Developer and/or, when necessary, the Department.

b. Public Meetings

i. The Developer shall host and facilitate one in person public meeting within one month of Financial Close to introduce the Developer to the local community. The Developer shall host at least two additional public meetings to be held at least two weeks prior to the issuance of NTP 2. One of these meetings may use the telephone town hall format. Additional public meetings shall be held at key construction phases, as identified by the Department. The Developer shall publicize the meeting through multiple means including local media, paid advertisements in newspapers, email, inserts in local newsletters, flyers, mailers and others. The Developer shall invite the stakeholder list provided by the Department which will include local elected officials, city/county staff, and surrounding Local Agencies. These meetings shall be held within the corridor boundaries; however the Developer shall host meetings in the neighborhood location closest to the upcoming construction work.

ii. These meetings shall inform attendees of Project plans and schedules and to provide information on how to receive updates on the Project (via email address list or the Department's GovDelivery messaging system). At the meeting, the Developer will provide Project displays that explain information on Construction Work, phasing, traffic impacts, etc. Project displays and other presentation materials used at the public meetings shall be of professional quality and designed to clearly convey accurate Project information to a non-technical audience. All displays shall be provided in English and Spanish.

c. Business and Community Meetings

i. The Developer shall organize and lead at least two meetings focused on local and regional business impacts prior to the issuance of NTP 2 and shall host additional meetings focused on local and regional business impacts at designated project phases as identified by the Department.

ii. The Developer shall, in coordination with the Department, respond to all feasible requests to attend regular community and stakeholder meetings, such as meetings organized by nonprofit groups and neighborhood and business associations. The Developer shall provide appropriate technical staff, as required.

d. Social Media

The Developer shall utilize the Department's social media platforms, including Facebook and Twitter, to share information with the public. All social media posts shall be Approved by the Department.

e. Stakeholder Distribution List

The Developer shall develop a master distribution list of contacts to be used for general PI, publications, and informational flyers/newsletters. The Department's database established through the I-70 East EIS shall be used as the basis for development of this list/database as well as the Department's GovDelivery messaging system. This list or database shall be presented to the Department for information prior to NTP 2. Through the Developer's data gathering process, the Developer shall assist the Department in supplementing the I-70 East database and the GovDelivery messaging system.

f. Tours and Communication Events

The Developer shall, at the request of the Department, be available to participate in all media, businesses and government official tours of the construction areas. The Developer shall participate in the coordination and delivery of communication events (e.g. groundbreaking or grand openings).

g. Lane Closure Reports

The Developer shall submit a Lane Closure Report each Thursday as required in Schedule 10, Section 2 Maintenance of Traffic, for the following week's Activities (Saturday through Friday). This report shall be provided to the list of contacts as provided by the Department.

h. Traffic Alerts

The Developer shall create a traveler alert for distribution on GovDelivery and COTRIP weekly. The alert shall include I-70 Mainline, CDOT Roadways, and Local Agency Roadways and any Activity that may impact the traveling public. The alerts will be established during the weekly Strategic Communications meetings.

i. Web Page Updates

The Developer shall work with the Department to develop internet web page content specifically for this Project and provide consistent updates with the latest Project information (web page development experience is not necessary as the Developer will supply information for the Department web page template). It shall contain all appropriate links to/from other sites if applicable, e.g., local city, county, bus service, etc. The Developer will ensure the web page is updated at least weekly with pertinent schedule information, new photos, contact information, etc.

j. Project Newsletters

The Developer shall prepare a quarterly newsletter. The first newsletter shall be distributed within 30 Calendar Days following the issuance of NTP 1 and be provided on a quarterly basis thereafter. The newsletter shall at a minimum provide summary information on the Project's purpose and schedule, list any upcoming job fairs or opportunities, list the Project

information line, email address, web address, Project map and a construction safety message, as defined by the Department. The newsletter shall be submitted to the Department for Approval prior to distribution. The Department will provide the Developer a newsletter template which will include the Project's logo. The Developer shall be responsible for distributing the newsletter via mail and email to the master distribution list of contacts as described in this Section.

k. Language Assistance for Limited English Proficient Persons

The Developer shall provide access to Limited English Proficient (LEP) persons. LEP persons are individuals for whom English is not their primary language and who have a limited ability to read, write, speak or understand English. The Developer's Community Liaison shall ensure LEP assistance for the Project including, but not limited to, translation of meeting notices and interpretation services at meetings. The Developer shall document all measures taken to communicate with LEP persons and record all requests for language assistance and submit with the CWCP quarterly report.

l. Public Communication Collateral

The Developer shall develop a variety of outreach collateral to share information, including coping strategies, to the public as necessary for major project milestones such as long-term Closures or impactful construction Activities (i.e. nighttime noise, restricted access, Utility impacts, etc.). The Developer's Community Liaison shall work with the Department to determine which collateral shall be used. Collateral could include newsletters, fact sheets, emails, flyers, social media updates, etc. The Developer shall use the Department provided branding on all PI materials throughout the Project and adhere to the CDOT *The Colorado Brand Guidelines*. The Developer shall not use its own logos or Subcontractors logos for public communications materials. All collateral material intended for broad distribution shall include Spanish translation.

m. Photos/Video

Without prejudice to the Developer's obligations to take photos under Section 10 of Schedule 8, the Developer shall take and submit photos/videos of the Work on regular intervals. A cell phone camera is permitted. Photographs/videos may include traffic control, paving, slope repair, erosion control, bridge deck and rail work, and other key areas of work identified by the Developer, Department, and PCM for use in reports to interested agencies, social media, and flyers. A minimum of two digital photographs/videos shall be submitted each month to the Department. The Developer shall also develop videos for public distribution to share progress of the Project either annually or at key project milestones. The Developer shall also develop videos as necessary to communicate key coping strategies as directed by the Department.

n. Project Identification Signing

The Developer shall provide one large project identification sign for each direction of travel along the I-70 Mainline at the Project limits. Sign layout and position shall be Accepted by the Department prior to installation. Project identification signs shall be placed within 30 Calendar Days following the issuance of NTP 1. Project identification signs shall be MUTCD compliant and contain the following information:

i. Project logo;

ii. Project start and estimated completion dates; and

iii. Developer name and PI hotline number;

o. The Developer shall conform to Table 1 in responding to correspondence from stakeholders and the public:

Table 1 Response Protocol

Type of Communication	Timing of Response
Hotline calls	Check messages throughout day Respond same day (initial call) or within 24 hours (including weekends if work is occurring)
Email	Same day (within two Working Days for high volume situations)
Call from Department staff	As soon as possible (no later than 24 hours)
Webpage inquiries	Same day (within two Working Days for high volume situations)
Public meeting inquires	Within one week of the meeting

5.3 CWCP Quarterly Reporting

5.3.1 The Developer shall prepare a quarterly report during the Construction Period. The initial report shall be provided to the Department for Acceptance 90 Calendar Days following the issuance of NTP 2. Each quarterly report shall be provided in English and Spanish translation, if requested by a member of the public, and shall include the following:

a. Details of primary Construction Work and O&M Work During Construction activities performed during the preceding quarter (refer to Progress Reports as required in Schedule 8 Project Administration);

b. Detailed summary of Strategic Communications as part of the Progress Report Activities performed during the preceding quarter;

c. Detailed summary of the ECWP as part of the Progress Report Activities, environmental mitigation summary, and summary of PM10 alert thresholds reached performed during the preceding quarter;

d. Detailed summary of Disadvantaged Business Enterprises (DBE)/Workforce Development Plan (WDP) Report and tracking during the preceding quarter;

e. Detailed summary of On the Job Training (OJT) and local hiring goals tracking during the preceding quarter;

f. Detailed summary of number of accidents cleared during the preceding quarter; and

g. Detailed summary of measures taken to communicate with LEP persons and requests for language assistance.

6. MAINTENANCE AND OPERATIONS COMMUNICATIONS PLAN

6.1 General Requirements

6.1.1 The Developer shall prepare and maintain an MOCP in coordination with the Department to develop two-way communication of Project information with the public. This MOCP shall be used throughout the duration of maintenance activities by the Developer to manage and implement the PI process. The MOCP shall be submitted to the Department for Approval prior to NTP 2. The MOCP shall include the following:

a. Planned Maintenance Projects

This outreach consists of providing regular and continuous PI services throughout the duration of the Operating Period. The Developer shall coordinate with the Department to determine which level of Public Information management (PIM) activities are warranted prior to completion of the maintenance or construction package. There are two tiers of planned maintenance projects which require Developer PIM activities.

i. Tier II PIM projects of medium to high impact which typically involve:

A. Moderate/High visibility from media/ public

B. Moderate/High stakeholder involvement

C. Moderate/High impact to traveling public/ stakeholders

D. Examples: Grand Ave. Bridge, I-25 in CO Springs, I-76 (Brush to Ft. Morgan), US 36 Lyons to Estes Park, US 160/US 550 CFI Durango

ii. Tier II PIM requirements apply under the following conditions:

A. The planned maintenance project is being conducted on a high-volume road with possibly a significant number of direct-access points/driveways;

B. The planned maintenance project is in or adjacent to a community's business center with high commuter/pedestrian/cycling traffic; changing work zones; variety of stakeholders (e.g., businesses, transit providers, commuters, tourists, etc.); and

C. The Department identifies a need for more consistent public information activities.

iii. Tier II PIM requirements

The Developer shall provide a professional-level PI manager to complete the following:

A. Host a public meeting prior to construction, as well as during, if warranted;

B. Gather and manage a planned maintenance project specific Stakeholder Distribution List;

C. Establish a project information number for posting on static construction signs;

D. Complete a Lane Closure Report each week;

E. Deliver project flyers to those residences/businesses with direct access to highway;

F. Meet with affected property owners as necessary;

G. Provide content for project web page, if warranted;

H. Answer and log calls/emails to the project information line/email address, tracking inquiries using Dialog; and

I. Assist with media relations.

iv. Tier III Projects are of medium impact which typically involve:

A. Moderate visibility from media/public

B. Moderate stakeholder involvement

C. Moderate impact to traveling public/ stakeholders

Examples: I-25 Lane Balancing, US 287 Resurfacing, US 50 Delta to Montrose resurfacing

v. Tier III PIM requirements apply under the following conditions:

The planned maintenance project is being conducted on a mid-volume road with possibly a significant number direct-access points/driveways, relatively high commuter/tourist traffic, changing work zones, and a need for consistent public information.

vi. Tier III PIM requirements

The Developer shall provide a professional-level PI manager to complete the following:

A. Establish a project number for construction signs, complete a Lane Closure Report each week;

B. Deliver project flyers to those residences/businesses with direct access to highway and email to specific highway users (defined);

C. Meet with affected property owners as necessary;

D. Provide content for project web page;

E. Answer and log calls/emails to the project information line/email address, tracking inquiries using Dialog; and

F. Provide information for press releases.

b. Safety-Related Complaints

The Developer shall report safety-related complaints to the Department within one Calendar Day of receipt by Developer unless the circumstance that is the subject of a complaint constitutes an immediate hazard in which case the Developer shall notify the Department as soon as practicable after the receipt of such complaint but in any event no later than 1 hour after receipt. The Developer shall respond to valid complaints or requests to the extent that the complaints or requests cover issues within the scope of the Developer's responsibilities under Schedule 11 Operations and Maintenance Requirements. The Developer shall convey any requests for services that are beyond the scope of its obligations under this Agreement to the Department. All complaints and response shall be recorded in the Dialog system.

c. Operations and Maintenance Education

This outreach consists of education messages to help clarify unfamiliar, complex or often misunderstood concepts related to the Project's long-term O&M, allowing the public to make informed decisions. Topics include HOV 3, Travel Demand Management, and accessing Tolled Express Lanes.

d. Maintenance and Operations Communications Plan Quarterly Reporting

The Developer shall prepare and submit quarterly maintenance and operations reports during the Operating Period. The initial report shall be provided to the Department for Acceptance 90 Days following Substantial Completion. Each quarterly report shall be provided in English and Spanish translation, if requested by a member of the public, and shall include the following:

i. Details of primary O&M Work activities performed during the preceding quarter (refer to Progress Reports as required in Schedule 8 Project Administration);

ii. Detailed summary of MOCP activities performed during the preceding quarter;

iii. Detailed summary of the ECWP as part of the Progress Report activities, environmental mitigation summary, and summary of PM10 alert thresholds reached performed during the preceding quarter;

iv. Detailed summary of DBE/WDP Report and tracking during the preceding quarter;

v. Detailed summary of OJT and local hiring goals tracking during the preceding quarter;

vi. Detailed summary of number of accidents cleared during the preceding quarter; and

vii. A summary of all calls as recorded in the Dialog system.

6.1.2 Emergency Maintenance

a. The MOCP shall establish a communications procedure for Emergency maintenance. The MOCP shall specify which communications tools will be utilized to communicate the impacts of repairs.

b. For Emergency maintenance, the Developer shall immediately provide the following information to the Department and the CTMC.

i. Description of the activity and why it is necessary;

ii. Start of the activity;

iii. End of the activity including any updates to the above;

iv. Impacts to traffic and property (businesses and residences);

v. Communications tools to share information (Variable Message Sign boards, GovDelivery alert, Twitter, photos, etc.); and

vi. Contact number.

c. Once work is completed the Developer shall also contact the Communications Manager and the CTMC.

7. CRISIS COMMUNICATIONS PLAN

7.1 General Requirements

7.1.1 The Developer shall prepare and maintain a CCP for the Developer's response to Emergencies and incidents at any time during the Term. The Developer shall coordinate this approach with the Developer's overall Incident Management Plan. The Developer's final CCP shall be submitted to the Department for Approval prior to the issuance of NTP 1.

7.1.2 In an event of a crisis, the Department will be the lead agency to handle communication with the media, public, the Department staff, etc. The Developer shall be available to help coordinate with the Department and provide information necessary to respond to the crisis.

7.1.3 The CCP shall include:

a. Types of potential Emergencies;

b. Designated staff to respond to the Emergency;

c. Approaches to addressing potential Emergencies; and

d. Boilerplate messaging that includes:

i. Cause of specific disruptions (whether construction related or not);

ii. Actions being taken to alleviate the problem;

iii. Impact to the public and notification procedures; and

iv. Anticipated duration of the disruption.

7.1.4 The Developer shall provide specific details on internal coordination and communication that will occur with the Developer team, the Department, and other stakeholders.

7.1.5 Emergency Information Dissemination - Communications Tree

The CCP shall include an Emergency response telephone and/or email tree established by the Developer. All appropriate personnel shall be included on this communications tree for immediate response in the event of an Emergency. The telephone/email tree shall be divided into areas of expertise so the proper people are called and/or emailed for specific Emergency situations. The Project Director, PCM, and the Developer shall be included on the communications tree for notification of any Emergency that may arise. The Developer shall develop and maintain a contact list of Emergency service providers as part of its CCP. The Developer shall provide

information to Emergency service providers. The Developer shall submit the Emergency response communications tree to the Department, for Acceptance, prior to the issuance of NTP 1.

8. DELIVERABLES

At a minimum, the Developer shall submit the following to the Department for Information, Acceptance, or Approval in accordance with the timeframes specified:

Table 2 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Construction Work Communications Plan (CWCP)	Approval	Prior to the issuance of NTP 1
Maintenance and Operations Communications Plan (MOCP)	Approval	Prior to the issuance of NTP 2
CWCP Quarterly Report	Acceptance	90 Calendar Days after issuance of NTP 2, quarterly thereafter
MOCP Quarterly Report	Acceptance	90 Calendar Days after issuance of NTP 2, quarterly thereafter
Crisis Communications Plan (CCP)	Approval	Prior to the issuance of NTP 1
Emergency response communications tree	Acceptance	Prior to the issuance of NTP 1
Operational hotline	Acceptance	Prior to the issuance of NTP 1
Stakeholder Distribution List	Acceptance	Prior to the issuance of NTP 2
Traffic alerts/media releases	Acceptance	48 hours prior to scheduled distribution date
Newsletters	Approval	Five Working Days prior to scheduled distribution date
Project identification sign layout	Acceptance	30 Calendar Days following the issuance of NTP 1
Fliers, posters or other public material	Approval	Five Working Days prior to the scheduled distribution date
Social media posts	Approval	Prior to RFC Documents
Web page content	Acceptance	Weekly

Schedule 15
Federal and State Requirements

[*To be provided in a subsequent Addendum*]

Schedule 16
Mandatory Terms

[*To be provided in a subsequent Addendum*]

Schedule 17
Environmental Requirements

1. GENERAL

[*Note to Proposers: At the time that this draft RFP is being written, the Final Environmental Impact Statement (FEIS), the Record of Decision (ROD), and the I-70 East Section 106 Programmatic Agreement have not been issued. This draft RFP is based on the assumption the findings of the FEIS will be similar to what has been published in the Supplemental Draft Environmental Impact Statement (SDEIS) and that the Final EIS, ROD, and other Environmental Approvals will be secured. The actual Environmental Requirements and required Environmental Mitigations will be finalized in the ROD. Proposers are advised that there may be substantial changes in Schedule 17 between this draft and the final RFP.*]

1.1 General Requirements

1.1.1 To the extent allowed by Law, subject only to the express provisions of this Agreement and without limiting the Developer's obligations to comply with all other Environmental Requirements applicable to the Project and the Work without requiring delegation by the Department, the Department hereby delegates to the Developer, and the Developer hereby accepts, all the Department's obligations, commitments and responsibilities for environmental management and environmental compliance in accordance with the requirements identified in this Agreement and all applicable Environmental Laws and Environmental Approvals. The Developer shall be responsible for creating environmental awareness among all Project personnel, ensuring completion of environmental tasks and mitigation, and documenting that the environmental aspects of the Construction Work and the O&M Work are completed in accordance with all applicable Environmental Laws, Environmental Approvals, and the provisions of this Agreement. The Developer shall also assist the Department to implement any and all non-delegable obligations, commitments and responsibilities regarding applicable Environmental Laws and Environmental Approvals. Unless specifically noted otherwise, the requirements of this Schedule 17 apply to all aspects of the Work, throughout the Construction Period and the Operating Period.

1.1.2 Except as provided otherwise in this Agreement and this Schedule 17, the Developer shall in performing the Work:

a. Comply with all Environmental Laws;

b. Comply with all conditions and requirements imposed by all Environmental Approvals;

c. Comply with all conditions and requirements imposed by all other Governmental Approvals (including all Department Provided Approvals);

d. Perform all commitments and mitigation measures set out in all Environmental Approvals and all other Governmental Approvals (including all Department Provided Approvals); and

e. Pursuant to Section 8.4 of the Agreement, prepare all information and submissions required by, or necessary to maintain in full force and effect, all Department Provided Approvals and maintain in full force and effect all Environmental Approvals.

1.1.3 For certainty, the provisions of this Schedule 17, including all obligations of the Developer hereunder, are without prejudice to the Developer's rights and obligations arising as a result of the occurrence of any Supervening Event.

2. ENVIRONMENTAL COMPLIANCE WORK PLAN

2.1 General Requirements

2.1.1 The Developer shall prepare an Environmental Compliance Work Plan ("ECWP") that specifically identifies all of the environmental goals and compliance requirements for the Project and the

Developer's detailed plan to meet or exceed those goals and requirements. The ECWP shall be submitted to the Department for Approval prior to issuance of NTP2.

At a minimum, the ECWP shall include the following:

a. All environmental elements defined in table "Summary of Impacts and Mitigation for the Preferred Alternative" in the ROD;

b. All elements assigned to the Developer in the I-70 East Mitigation Measures Status as provided in Schedule 29 (*Reference Documents*);

c. All elements required by Environmental Laws and Environmental Approvals;

d. Description of the means and methods to meet all Environmental Requirements during both the Construction Period and the Operating Period. (To include, for example, detailed procedures that the Developer shall utilize to meet Environmental Requirements for dewatering in the Construction Period and the Operating Period and any Government Approvals for removal, management, and disposal of RMHs the Developer shall seek.)

e. Description of the process for tracking and documenting the progress and completion of all Environmental Requirements throughout the Construction Period and the Operating Period;

f. Description of how the Developer's Process Control (PC) and Independent Quality Control (IQC) programs shall function to assure compliance with Environmental Requirements and this Agreement;

g. Description of how information related to progress, completion and compliance with Environmental Requirements will be communicated to the Department and recorded in the Developer's DCS; and

h. Description of the roles, responsibilities and qualifications for all members of the Developer's environmental management team, including the Environmental Manager (EM).

2.1.2 All plans required by this Schedule 17, including the ECWP and those listed below, shall be written to assure compliance with all Environmental Laws, Environmental Approvals, and this Agreement. The plans listed below shall be referenced by the ECWP and shall be considered supporting elements of the ECWP:

a. Air Quality Monitoring, Maintenance, and Mitigation Plan;

b. Construction Noise Mitigation and Monitoring Plan;

c. Integrated Noxious Weed Management Plan;

d. Materials Management Plan;

e. Sampling and Analysis Plan;

f. Health and Safety Plan;

g. Spill Prevention Control Countermeasure Plan; and

h. Black-tail Prairie Dog Management Plan,

and, as such, the provisions set out in Section 2.2 of Schedule 8 (*Project Administration*) shall apply.

3. INDEPENDENT QUALITY CONTROL PROGRAM

The Developer's IQC program, as described in Schedule 8 (*Project Administration*), shall assure compliance with all Environmental Requirements. The Developer shall perform IQC inspections to assure that the Construction Work meets and is being performed in accordance with this Agreement and Environmental Requirements.

4. ENVIRONMENTAL STATUS AND MITIGATION COMPLETION REPORTS

The Developer shall report on the status of activities under taken in accordance with the Environmental Requirements on a regular basis. During the period beginning with NTP2 through the Substantial Completion Date, the EM shall submit an Environmental Status Report (ESR) monthly for Acceptance. During the Operating Period the Developer shall submit an ESR quarterly for Acceptance. The ESR shall be submitted within 15 Calendar Days following the end of the reporting period. The ESR shall:

a. Include the current status of compliance with the Environmental Requirements;

b. Document any pertinent environmental issues and include a narrative of the compliance actions and environmental activities which have occurred during the reporting period;

c. Include a summary of any stakeholder communications and Governmental Authority communications that have occurred during the reporting period;

d. Include a summary that lists the plan sets and submittals which have undergone environmental cross-disciplinary review since the last ESR;

e. Include dated photographs documenting environmental compliance and activities; and

f. Include any other content requirements specified in this Schedule 17.

4.1.2 All narratives shall include enough detail to fully document the environmental activities. If the Department requests additional information be included in an ESR, the Developer shall revise the ESR and resubmit the report for Acceptance.

4.1.3 When all Environmental Requirements and environmental activities associated with the Construction Work that have been assigned to the Developer are complete, the Developer shall provide a Mitigation Completion Report. The Mitigation Completion Report shall document and certify the completion of all Environmental Requirements including environmental mitigation. The Developer shall submit the Mitigation Completion Report, for Acceptance, prior to Final Acceptance.

5. ENVIRONMENTAL MANAGER

5.1 General

5.1.1 The Developer shall employ an Environmental Manager (EM) to be responsible for ensuring compliance with all Environmental Requirements and commitments. The Environmental Manager shall implement all the environmental design, construction and operational commitments, all Environmental Requirements, and all conditions of the Environmental Approvals for the Project The EM shall have the authority to stop or redirect the Work at any time as needed. The EM shall be responsible for the following:

a. Be the primary liaison between the Developer and the Department on environmental issues.

b. Be the lead responder to any non-compliance findings issued by the Department or the Independent Quality Control Manager (IQCM) for the Work.

c. Provide support to the IQCM to ensure compliance with Environmental Laws and Environmental Approvals is included in construction inspection.

d. During Construction, the EM shall conduct a weekly field review of the entire Project. A summary of the field reviews shall be included in the ESR.

e. Coordinate the implementation of procedures to meet all Environmental Requirements.

f. Ensure full compliance with all Environmental Requirements in the Work.

g. Ensure that environmental tasks are performed by qualified environmental professionals and provide the resources to perform the Work needed to meet the Environmental

Requirements. Activities performed by environmental professionals shall be reported in the ESR and include the resumes of the individuals performing the Work.

h. Lead environmental cross-disciplinary reviews of all design submittals to confirm compliance with all Environmental Requirements and environmental design commitments and include a summary of the findings in the ESR.

i. Perform reviews of proposed Changes prior to submittal to the Department for Approval. The submittal of a proposed Change by the Developer to the Department shall include documentation that the EM has performed due diligence and that the proposed Change complies with the Environmental Requirements. A summary of these reviews shall be reported in the ESR.

j. Measure the number and severity of non-conformances with the Environmental Requirements and include a summary of the findings in the ESR.

k. Implement improvement strategies to reduce the number and severity of non-conformances with the Environmental Requirements and include a summary of the findings in the ESR.

l. Monitor Work for conformance with Environmental Requirements and include a summary of the findings in the ESR.

m. Plan and implement the Environmental Compliance and Mitigation Training Program described in this Schedule 17.

n. Lead a field review with the Department to review the Project and environmental issues every month during the Construction Period. This field review can be counted as a substitute for the EM's weekly field review.

o. Lead the weekly Environmental Task Force meetings as described in Schedule 8 (*Project Administration*). These meetings shall continue through the Construction Period. Include the minutes of these meetings in the ESR for the appropriate period.

p. Attend all public meetings and participate as needed.

q. Provide Mitigation Completion Report documenting and certify the completion of all Environmental Requirements.

5.1.2 The EM's responsibilities shall not be delegated to production staff or other Persons without Department Approval.

6. ENVIRONMENTAL COMPLIANCE AND MITIGATION TRAINING PROGRAM

6.1 General Requirements

6.1.1 The Developer shall develop and implement an Environmental Compliance and Mitigation Training Program (ECMTP) for the Developer's supervisory personnel, including those of Subcontractors who will enter within the Site boundaries to perform Construction Work. In addition, IQC inspectors, supervisory staff, and the IQCM shall participate in the ECMTP. The ECMTP shall provide supervisory personnel and inspectors with an understanding of all Environmental Requirements for the Project and train them to stay in compliance with the Environmental Requirements. The ECMTP shall specify training that supervisory personnel shall provide to other non-supervisory personnel in environmental compliance practices.

6.1.2 The ECMTP shall include the following elements:

a. Water quality requirements;

b. Maintaining approved limits of disturbance;

c. Tree and shrub protection;

d. Avoidance and minimization of impact to waterways and stormwater conveyances;

e. Seasonal work restrictions – trees, waterways, and migratory birds;

f. Pumping and dewatering operations;

g. Discovery of archaeological material or human remains;

h. Discovery of paleontological resources;

i. Hazardous Substances;

j. Historic property protection requirements;

k. Construction noise mitigation;

l. Dust and construction emissions mitigation;

m. Site general housekeeping measures;

n. Concrete and asphalt waste material management;

o. Spill prevention, response, and cleanup;

p. Protection and access requirements for parks and maintenance of trail detours;

q. Impacts and consequences for departure from approved operating procedures;

r. Instruction to supervisors for training their direct reports in the required procedures, practices, and techniques to maintain environmental compliance;

s. Additional topics as needed to maintain compliance with the Environmental Requirements; and

t. Responsibilities of production supervisors and inspectors in connection with environmental compliance.

6.1.3 The EM shall implement the ECMTP and submit it to the Department for Acceptance prior to issuance of NTP2. After NTP2 the Developer shall not allow any personnel to begin Work on the Site without completing the training required by the ECMTP. Work conducted on the Site prior to NPT2 shall be conducted under the environmental requirements of the CDOT Special Use Permit and otherwise subject to the early access and use provisions set out in Section 1.2 of Schedule 18. The Developer shall revise the ECMTP regularly to reflect the most current policies, rules, and regulations and provide annual updates to the ECMTP to the Department for Acceptance 30-days after the reporting period. The Developer shall keep records of the number of sessions and staff who has completed the ECMTP and report this information, including the sign in sheets, annually in the ESR.

7. DEPARTMENT PROVIDED ENVIRONMENTAL APPROVALS

The Department will obtain the Environmental Approvals listed in Table 1. Unless specifically exempted, the Department hereby delegates to the Developer responsibility to perform all conditions, commitments, and requirements contained in or arising out of the Department Provided Approvals.

Table 1 Department Provided Approvals

Environmental Approvals	Permitting Agency/Approval Agency
Record of Decision and Section 4(f) Evaluation	Federal Highway Administration (FHWA)
I-70 East Section 106 Programmatic Agreement	State Historic Preservation Office (SHPO), Colorado Department of Transportation (CDOT) and FHWA

8. REQUIRED ENVIRONMENTAL APPROVALS

Pursuant to Section 8.4 of the Agreement, the Developer shall obtain all Environmental Approvals and Governmental Approvals required to complete the Project, other than the Department Provided Approvals. A list of the potential Environmental Approvals that the Developer shall

obtain is found in Table 2. The Developer shall obtain any additional Required Environmental Approvals not listed in Tables 1 or 2. The Developer shall be responsible for any delays associated with obtaining Required Environmental Approvals.

Table 2 Required Environmental Approvals

Environmental Approvals	Permitting Agency/Approval Agency
Air Pollutant Emission Notice (APEN)	Colorado Division of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD)
Stationary Source Air Quality Permit	CDPHE, APCD
Fugitive Dust Permit	CDPHE, APCD
Asbestos Abatement Permit	CDPHE, APCD
Demolition permits	CDPHE and all applicable Governmental Authorities
Construction Noise Permit	All applicable Governmental Authorities
Temporary Noise Variance	All applicable Governmental Authorities
Clean Water Act Section 402 Construction Dewatering Permit	CDPHE Water Quality Control Division (WQCD)
Construction Activities Stormwater Discharge Permit (CASDP)	City and County of Denver (CCD) – Wastewater Management
Colorado Discharge Permit System (CDPS) Stormwater Construction Permit (SCP)	CDPHE WQCD
Municipal Separate Storm Sewer System (MS4) Discharge Permit (CDOT MS4 discharge requirements)	CDPHE WQCD
Municipal Separate Storm Sewer System (MS4) Discharge Permit (outside CDOT ROW)	All applicable Governmental Authorities
Subterranean Groundwater Permit	CDPHE WQCD
Construction Dewatering Permit	CDPHE WQCD
Remediation Activities Discharging to Surface Waters Permit	CDPHE WQCD
Remediation Activities Discharging to Groundwater	CDPHE WQCD
Substitute Water Supply Plan	Colorado Division of Water Resources
Notice of Intent to Construct Dewatering Wells	Colorado Division of Water Resources
Notification as Resource Conservation and Recovery Act (RCRA) Generator.	CDPHE Hazardous Materials and Waste Management Division
Stormwater Quality Discharge Permit for Construction Activities	City of Aurora
Sewer Use and Drainage Permit (SUDP)	CCD
Well Abandonment Report (GWS-09)	State of Colorado, Office of State Engineer
Black Tailed Prairie Dog Removal Permit	Colorado Parks and Wildlife (CPW)
SB40 Certification/Approval	CPW
Nest Take Permit	The United States Fish and Wildlife Service (USFWS)
Clean Water Act Section 404 Permit	United States Army Corps of Engineers (USACE)
Special Use Permit	Colorado Department of Transportation

9. NEW ENVIRONMENTAL APPROVALS

9.1 General Requirements

9.1.1 A New Environmental Approval shall consist of a modification to a Department Provided Approval, a modification of an existing Required Environmental Approval, or an additional Required Environmental Approval not anticipated in this Schedule 17. In the event that the Developer's design, construction, or operational activities trigger the need for New Environmental Approval(s), the Developer shall pursuant to Section 8.4 of the Agreement:

a. obtain the required New Environmental Approval(s);

b. perform any and all analysis, documentation, reports, and prepare and submit the application packages required to obtain any New Environmental Approval;

c. be responsible for any delays associated with obtaining required New Environmental Approvals; and

d. coordinate with the Department prior to applying for a New Environmental Approval.

9.1.2 The Developer shall not pursue obtaining New Environmental Approvals for actions that are not described in the Preferred Alternative and Reference Documents without Department Approval of the proposed action. The requirements of Section 9.1.1 of this Schedule 17 shall also apply to any agreements the Department has made with State and local authorities (for example, the Section 106 Programmatic Agreement.)

9.1.3 In cases that require the Department to act as the coordinating Party with a Governmental Authority in which case Section 8.4.4 of the Agreement shall apply, the Developer shall pursuant to Section 8.4 of the Agreement perform any and all analysis, documentation, reports, and prepare the application packages necessary to secure any New Environmental Approval. For example, official consultation with the USFWS must occur through FHWA. In this case the Developer shall prepare all required material, however official consultation shall be coordinated by the Department and FHWA.

9.1.4 Without limiting the Developer's obligations to comply with the Environmental Requirements, the Developer shall consult with the Department to determine any appropriate New Environmental Approval to request. The Department may, at its discretion, require the Developer to submit the Colorado Department of Transportation's Reevaluation Form (CDOT Form No.1399) in connection with obtaining a New Environmental Approval.

9.2 Potential New Environmental Approvals

9.2.1 Table 3 contains a non-exhaustive list of New Environmental Approvals that could be required if design, construction, or operational activities by the Developer change the Reference Design.

Table 3 New Environmental Approvals

Approvals	Permitting Agency/Approval Agency
Categorical Exclusion (CE)	FHWA
Environmental Assessment (EA)	FHWA
Finding of No Significant Impacts (FONSI)	FHWA
Environmental Impact Statement (EIS)	FHWA
Supplemental Environmental Impact Statement (SEIS)	FHWA
ROD	FHWA
Reevaluation (CDOT Form #1399)	FHWA
Section 106 Programmatic Agreement	SHPO

10. ENVIRONMENTAL REQUIREMENTS FOR SPECIFIC ENVIRONMENTAL RESOURCES

10.1 General

10.1.1 The Environmental Requirements for specific environmental resources are set out in the Schedule 10A (*Applicable Standards and Specifications*), including I-70 East Mitigation Measures Status and the I-70 East EIS. In addition, the Environmental Approvals and this Schedule 17 contain additional Environmental Requirements and/or clarifications of Environmental Requirements for specific individual environmental resources.

10.1.2 All environmental resources within and adjacent to the Site which are to be protected from disturbance during construction (for example wetlands and historic resources) shall be clearly shown on the Release for Construction (RFC) Documents. The techniques and methods to be used for protection of the environmental resource (for example fencing and signage) shall be shown in the RFC Documents. The protective measures shall be put in place prior to work beginning in the area and maintained through the Construction Period.

11. AIR QUALITY

11.1 **General Requirements**

11.1.1 The Developer shall comply with all applicable air quality regulations and shall prepare and submit an Air Quality Monitoring, Maintenance, and Mitigation Plan (AQ3MP), for Acceptance, prior to issuance of NTP2.

11.1.2 The Developer shall be responsible for obtaining all air quality Permits necessary to complete the Work, including but not limited to those listed in Table 2. The Developer shall have sole responsibility for compliance with of all applicable air quality Environmental Approvals.

11.1.3 Air Quality Monitoring, Maintenance, and Mitigation Plan

a. The Developer shall prepare and implement the AQ3MP using the CDOT Air Quality Monitoring, Maintenance, and Mitigation Template. All template section and subsection headings shall be used. If a section or subsection is not applicable, the reason it is not applicable shall be specified. New sections or additional subsections shall be added as necessary to fully describe the AQ3MP, identify personnel responsibilities, describe technical methodologies, list assumptions, and present procedures and methods for documenting and reporting. The AQ3MP will include the following:

i. Fugitive Particulate Emission Control

The Developer shall monitor Project fugitive particulate emissions including those from construction equipment and stationary sources. The Developer shall perform and document a daily visual inspection of active Work sites within the construction site boundary with the goal of preventing off-site transport of fugitive particulate emissions. If off-Site transport of fugitive particulate emissions occurs and is observed by the Developer or is reported to the Developer, the observer or the Developer representative who received the report shall immediately inform the EM and the Construction Manager or, if not available, the next highest-ranking member of the construction team. The Construction Manager shall implement appropriate Best Management Practices (BMP)s.

ii. Opacity Measurements

The Developer shall perform and document daily opacity readings from all stationary sources that are operated on the Site that are subject to opacity limits in Section II.A of Air Quality Control Commission Regulation No. 1 (5 CCR 1001-3) and any applicable Permit conditions. The Developer's personnel performing opacity readings shall be certified according to State and Federal standards and the certification status maintained throughout the duration of the Construction Work. The personnel performing the daily opacity readings on stationary sources may be the same personnel inspecting the Site for off-Site transport of pollutants. If opacity readings exceed allowable limits, the inspector shall immediately inform the EM and the

Construction Manager. The Construction Manager shall implement effective BMPs as described in I-70 East Mitigation Measures Status.

iii. PM-10 Monitoring

The Developer shall conduct continuous PM-10 monitoring during the Construction Period in accordance with 40 CFR Part 58 Ambient Air Quality Surveillance adequate to characterize PM-10 concentrations along the active construction corridor. The AQ3MP shall specify the number, type, and location of PM-10 monitors that will make up the network and shall provide for hourly sampling. All data is to be made available online at a publically accessible website after the data has been checked for quality. Data shall be posted within one week of being collected. At each station a PM-10 sampler will be installed in a climate controlled facility. The stations shall be designed to meet all applicable Federal, Environmental Protection Agency (EPA), and Colorado APCD standards. The Developer shall select PM-10 monitoring locations consistent with EPA siting criteria for surface data collection and shall provide rationale for location selection. Locations of the PM-10 monitors shall be adjusted during the Construction Period to accommodate construction phasing. Proposed locations of the PM-10 monitors shall be submitted to the Department for Acceptance at least two weeks prior to operating the monitor at the proposed location.

iv. Meteorological Data Collection

The Developer shall continuously monitor meteorological conditions including on-Site wind-speed and wind gusts, wind azimuths, barometric pressure, and temperature, to assist in making decisions regarding mitigation of fugitive particulate emissions. This data may be collected at the PM-10 monitors or the Developer may obtain data from existing local data sources. If data is obtained from local sources, the sources being used shall be listed in the AQ3MP.

v. Project Independent Air Monitoring Data from Swansea Elementary

Air quality will be monitored at Swansea Elementary School as part of an independent research project that is separate from the Developer's Project. It is expected that the following criteria pollutants will be monitored: nitrogen dioxide (NO2), PM-10, and PM-2.5. Additional pollutants may be added to the monitoring list. Monitoring results will be made available to the Developer approximately one week after the data is collected. The Developer shall review such data as it becomes available to identify trends to help determine if BMPs are being used effectively.

vi. Automated PM-10 Alert System

The Developer shall implement an automated PM-10 alert system that will communicate via both text messaging and email when a PM-10 monitored level reaches a running eight hour average concentration of 135 µg/m^3. This alert system will continuously monitor the real time data from the Project's PM-10 monitors. The level of 135 µg/m^3 is specified in order to allow corrective actions to be implemented prior to exceeding the National Ambient Air Quality Standard (NAAQS) of 150 µg/m^3. The alert system shall inform the Construction Manager, EM, designated Department staff, and designated CDPHE Air Pollution Control Division staff of the PM-10 concentration and location of the alerting monitor. Upon receiving an alert, the Construction Manager shall respond immediately to identify the source of the PM-10 event and implement effective BMPs for dust control. This mitigation will continue until the next running 8-hour PM-10 concentration from the alerting monitor is below 135 µg/m^3. All actions associated with responding to a 135 µg/m^3 or greater reading shall be communicated with the EM, designated Department staff, and designated CDPHE Air Pollution Control Division staff via email within one hour of the event.

vii. Posting of PM-10 Data

The Developer shall post the eight-hour running PM-10 data to a dedicated webpage that is available to the public. Weather data shall also be posted to such webpage. The webpage shall be of professional quality, modeled after the EPA's Village Green Project, and be functional as both a standard webpage and on mobile devices.

viii. Air Quality BMPs

The Developer shall provide a list of air quality BMPs that the Developer will use for Construction Work and a description of how each will be implemented. BMPs are listed in the I-70 East EIS and other Environmental Approvals.

11.1.4 Air Quality Reporting

a. The Developer shall maintain a daily log of air quality observations and mitigation measures during all phases of the Construction Work and shall provide a monthly report and the monthly log of data collected to the Department in the ESR. The log shall include a daily report of the following information:

i. A description and location of construction activities being conducted on that day that could negatively impact air quality, including, for example, excavation, clearing and grubbing, demolition, and utilizing unpaved staging areas and haul roads.

ii. A report on the daily visual inspection of the Site, including a description of any visible emissions.

iii. The results, time and location of all opacity readings.

iv. A report on any off-Site transport of visible emissions, and any violation of any other emissions guideline in Regulation No. 1, Section III.D. The report shall describe the duration of the event, the mitigation measures deployed and actions taken, and the time it took to correct the problem.

v. A report on any violation and compliance deficiency of the AQ3MP or Environmental Approval relating to air quality. The report shall describe the duration, time, and location of the event; the mitigation measures deployed and actions taken; and the time it took to correct the problem.

vi. All hourly PM-10 and weather monitoring data and hourly eight-hour running average data from the PM-10 monitoring network and the meteorological monitoring station shall be recorded in a digital data logging unit and transmitted by a cellular or satellite system to an online data depository hourly managed by the Developer.

11.1.5 Heavy Equipment

The Developer shall use heavy construction equipment with the cleanest available engines. Class 4 diesel equipment older than 2007 shall be retrofitted with diesel particulate control technology and engine preheaters prior to use for the Project. Where feasible, the Developer shall use alternatives to diesel engines and/or diesel fuels, such as biodiesel, liquefied natural gas, or compressed natural gas, fuel cells, and electric engines. The Developer shall report quarterly on heavy equipment fleet in use for the Project, and document the actions taken to meet the air quality commitments from the ROD.

11.1.6 Construction Equipment Emissions Retrofit Program

The Department has secured funding and a commitment from the Regional Air Quality Council (RAQC) to retrofit certain types of construction equipment to reduce emissions. The Developer shall review its fleet to determine if any its vehicles could benefit from this program and report to the Department the results of this review. The Developer is encouraged to participate in the retrofit program.

12. NOISE

12.1 General Requirements

The Department has performed a noise impact analysis with abatement recommendations as part of the preliminary design for the I-70 East EIS. The Statement of Likelihood and recommendations of this analysis are included in Section 5.12 of the FEIS and in the Noise Technical Report (Attachment K) of the FEIS. The noise analysis was completed using the geometry assumptions documented in the FEIS .

12.2 Noise Analysis and Report

12.2.1 The Developer shall perform a noise analysis based on its final design. Results of the noise analysis shall be documented in a preliminary and final Noise Technical Report and submitted to the Department for Acceptance. For information the FHWA Traffic Noise model (TNM) used in the EIS analysis is available to the Developer as provided in Schedule 29 (*Reference Documents*).

12.2.2 The preliminary and final design noise analysis and Noise Technical Report shall follow the format of the EIS analysis referenced above and include the same receiver locations as well as any new receivers that exist due to land use changes. The preliminary and final design noise analysis shall utilize the same model used in the EIS and shall be produced in accordance to the standards and procedures of the CDOT *Noise Analysis and Abatement Guidelines*.

12.2.3 The noise analysis and Noise Technical Report shall determine and document the noise effects of any changes to the vertical and horizontal alignment from the Reference Design. The noise analysis and Noise Technical Report shall include a detailed description of the locations where the horizontal and vertical roadway elevations have changed from the Reference Design. The noise analysis and Noise Technical Report shall determine if any new neighborhoods have become eligible for noise abatement. If any new areas become eligible for noise abatement due to changes to the vertical or horizontal alignment, the Developer shall include the analysis for recommended noise abatement in the noise analysis and report. The Developer shall assure proposed mitigation is consistent with mitigation standards identified in the I-70 East EISState and Federal guidelines. The Developer shall submit documentation with the noise analysis and Noise Technical Report verifying that the analysis was performed by a qualified individual with expertise in the field of highway noise analysis in Colorado. If additional noise abatement is required due to the Developer initiated changes to the vertical or horizontal alignment, all costs for the additional noise abatement shall be borne by the Developer.

12.2.4 Top of existing noise barrier elevations shall be documented before the removal of any existing structure. If final design noise analysis determines that top of barrier or structure elevations are lower than their existing elevations, the Developer shall demonstrate that no new visual sight lines are created.

12.3 New Noise Abatement

12.3.1 New noise abatement is required in the areas identified in the I-70 East EIS. The Developer shall optimize the design of the noise abatement infrastructure to maximize the number of receivers receiving a reduction of 5 dBA or greater per CDOT/FHWA guidelines.

12.3.2 The Developer shall submit a preliminary Noise Technical Report which contains the optimized design of the proposed noise abatement in the affected neighborhood. Acceptance of the preliminary Noise Technical Report is required before the Benefited Receptor Preference Survey can be conducted.

12.3.3 When the preliminary Noise Technical Report has been Accepted by the Department, the Developer shall conduct the Benefited Receptor Preference Survey as described in the CDOT *Noise Analysis and Abatement Guidelines*. The Developer shall provide all material necessary to conduct the survey including exhibits, flyers, door hangers, ballots and return mail envelopes. The Developer shall conduct a public meeting on the proposed noise abatement design. The Developer shall allow the Department the opportunity for ongoing over the shoulder review of all planning activities associated with the Benefited Receptor Preference Survey. The Developer

shall submit for Approval the plan of the Benefited Receptor Survey, including the geographic limits of the survey, procedures for conducting the survey, and printed material and other media to be used for the survey at least 14 Calendar Days before completing the survey.

12.3.4 Additional new noise abatement will be required if changes to the final vertical or horizontal alignment, or any new Type I action, trigger eligibility as referenced in the Noise Analysis and Report subsection above. New noise abatement infrastructure requirements triggered by changes to the geometry shall be the responsibility for the Developer.

12.3.5 After the Benefited Receptor Preference Survey is completed, a Final Noise Technical Report shall be completed to document the final design noise analysis, final geometry and details of the noise barriers. This report shall be submitted to the Department for Acceptance prior to RFC Documents.

12.4 Existing Noise Abatement

12.4.1 All existing noise abatement structures that are removed, damaged, or otherwise impacted as a result of the Construction Work shall require full replacement. Replacement noise abatement structures shall be constructed to the structural and aesthetic requirements as set out in the Technical Requirements and Section 14 of Schedule 10 (*Landscaping and Aesthetics*). Noise abatement structures on the existing viaduct are excluded from this requirement.

12.4.2 Additional Noise Abatement Requirements

a. Proposed noise walls shall be placed in locations that will accommodate the Ultimate configuration.

b. Noise walls and other abatement measures shall follow the requirements set out in Section 14 of Schedule 10 (*Landscaping and Aesthetics*).

c. Noise walls shall be designed and constructed without open joints or gaps. Joints between noise wall Elements shall be minimized. Where joints are necessary, they will be designed is such a way that no light can pass through them. If a sealant is utilized to close any joint, it shall have a design life equal or greater than the wall. Proposed noise wall designs and location information shall be included in the Developer's public information program.

12.5 Construction Noise Mitigation and Monitoring

12.5.1 The Developer shall comply with all applicable local sound control and noise and vibration ordinances and regulations, including the use of variances. All required noise permits shall be acquired by the Developer prior to issuance of NTP2.

12.5.2 I-70 East Mitigation Measures Status contains mitigation measures for construction noise and vibration. The Developer shall implement a Construction Noise Mitigation and Monitoring Plan (CNMMP) that incorporates the mitigation measures outlined in the I-70 East EIS. The Developer shall submit the CNMMP to the Department for Acceptance prior to issuance of NTP2. The CNMMP shall be comprehensive and provide accurate and detailed information to minimize, monitor and mitigate construction-related noise and include:

a. Compliance procedures with mitigation measures outlined in the I-70 East EIS.

i. Compliance procedures with applicable noise ordinances or variances granted for the Project;

ii. Methodology to establish baseline ambient conditions;

iii. Identification of sensitive receptors, for both day and night construction and other Project-related activities;

iv. Procedures for monitoring and reporting noise levels for the Project;

v. Methodology to prevent, minimize and mitigate noise impacts related to demolition, debris removal, hauling, construction equipment, and construction activities.

vi. Implementation plan to construct noise barriers prior to roadway construction;

vii. Implementation plan to replace noise barriers as they are removed in locations that have existing noise barriers; and

viii. Implementation plan to meet construction noise minimization requirements around the Swansea Elementary School.

13. HISTORIC RESOURCES

13.1 General Requirements

13.1.1 The Developer shall preform all mitigation measures assigned to the Developer in this Schedule 17 and the I-70 East Mitigation Measures Status.

13.1.2 The Developer shall include the line work showing the Area of Potential Effect (APE) boundary on all design drawings.

13.1.3 If the Developer's Work results in any changes in effects to the historic resources described in the I-70 East EIS or in changes to the APE, the Developer shall obtain all required New Environmental Approvals. The Developer shall document those changes and provide the Department with all necessary information and reevaluations for coordination with SHPO under Section 106 of the National Historic Preservation Act. This shall include any additional easements (temporary or permanent), property acquisitions, or Utility Relocations that were not previously cleared as part of the Section 106 consultation and Section 106 Determinations of Eligibility and Effects report (Attachment I to the FEIS). The Developer shall not impact historic resources until the Section 106 consultation process is complete and Approved by the Department, FHWA, and SHPO. The Developer shall also be responsible for updating the Section 4(f) evaluation and obtaining Approval for any modifications to the Section 4(f) evaluation.

13.1.4 The Developer shall protect in place all identified historic resources that are to remain through the Construction Period. Protection measures shall include fencing and additional measures referenced in I-70 East Mitigation Measures Status and/or the I-70 East Section 106 Programmatic Agreement.

14. SWANSEA ELEMENTARY SCHOOL

14.1 General Requirements

14.1.1 Prior to beginning Construction Work in the Swansea Elementary School area, the Developer shall construct the temporary wall as described in Section 14 of Schedule 10 (*Landscaping and Aesthetics*).

14.1.2 The Developer shall minimize construction activities and construction impacts around Swansea Elementary School during school hours. The Developer shall include mitigation activities associated with Swansea Elementary school in the CNMMP, the AQ3MP and all other applicable plans. The Developer shall include the Swansea Elementary School Principal and appropriate Denver Public School District personnel in the Strategic Communication Plan and keep them fully informed of all activities adjacent to the school.

14.1.3 Construction staging shall not occur within 500 feet of Swansea Elementary School.

15. PALEONTOLOGY

15.1 General Requirements

15.1.1 The Developer shall employ a professional paleontologist, permitted through the Office of the State Archaeologist. During the Construction Period when the Denver and Arapahoe Formations are not exposed, the Developer's paleontologist shall spot check the Site weekly. During the Construction Period when bedrock of the Denver and Arapahoe Formations are exposed, the Developer's paleontologist shall provide continuous paleontological monitoring.

15.1.2 The Developer's paleontologist shall communicate with the Department to provide seven days notification to the Department's paleontologist informing them when work in the Denver and Arapahoe Formations is scheduled.

15.1.3 The Developer's paleontologist shall provide all reports required by the terms of their permits to the appropriate Governmental Authority and submit copies to the Department. The Developer's Paleontologist shall provide a monthly summary of their activity on the Site to be included in the ESR. The Developer's Paleontologist shall provide Paleontological Annual Reports to the Department for Acceptance detailing work completed and fossils collected and curated to the Department. When all earthwork is completed, the Developer's paleontologist shall provide an end of Project Paleontological Summary Report to the Department for Acceptance.

15.1.4 During the Construction Period, the Developer's Paleontologist shall communicate directly with the Department's Paleontologist and allow on going over the shoulder review of all field activities. The Developer shall immediately notify the Department in the event of any discovery.

15.1.5 Upon discovery of any paleontological resources, the Developer shall immediately cease Work in the vicinity of the discovery, fence off the area, and allow the Developer's Paleontologist to conduct sampling or excavation of specimens by hand or with mechanized equipment. If the Paleontologist collects any specimens, all materials shall be curated following guidance provided in 8 CCR 1504-7 – Historical, Prehistorical, and Archaeological Rules and Procedures. The Developer shall not resume Construction Work in the area until receiving formal notification from the Developer's Paleontologist allowing Construction Work to resume.

16. PARKS AND RECREATION

16.1 General Requirements

16.1.1 The Developer shall reconfigure the Swansea Elementary School site and replace all playground facilities as directed in Section 14 of Schedule 10 (*Landscaping and Aesthetics*).

16.1.2 During the Construction Period, segments of the South Platte River Greenway Trail and the Sand Creek Greenway Trail may be subject to temporary detours. The Developer shall provide trail detour signage that complies with the Americans with Disabilities Act of 1990 and Part 6F of the FHWA *Manual on Uniform Traffic Control Devices*.

16.1.3 Any reconstructed trail segment shall be rebuilt at minimum to match the existing facility. Trail surfacing on any rebuilt trail segments will be constructed with new material and have smooth transitions to the undisturbed segments.

16.1.4 The outfall and any additional visual Project Elements in Globeville Landing Park shall be as set out in Section 14 of Schedule 10 (*Landscaping and Aesthetics*). The Department will conduct the required Section 6(f) mitigation off-Site. If impacts to the Globeville Landing Park exceed those identified in the I-70 East EIS, the Developer shall be responsible for all 6(f) coordination and mitigation.

17. VEGETATION

The Developer shall minimize tree removal and disturbance to native plant communities, especially wetlands, prairie dog towns, riparian areas, and upland trees and shrubs. All native and non-native trees outside of Senate Bill 40 (SB 40) jurisdictional areas that are removed that are over four inches diameter at breast height shall be replaced with native trees on a 1:1 basis. All riparian shrubs outside of Senate Bill 40 jurisdictional areas that are removed shall be replaced with native shrubs based on areal coverage on a 1:1 basis. New and replacement vegetation shall conform to Section 14 of Schedule 10 (*Landscaping and Aesthetics*). Additional requirements to avoid, minimize, and mitigate for impacts to vegetation are found in the I-70 East EIS.

18. SENATE BILL 40 WILDLIFE CERTIFICATION

18.1 General Requirements

18.1.1 The Developer shall evaluate the final design to determine if and how the SB 40 Application Criteria apply as defined by CDOT's *Guidelines for Senate Bill 40 Wildlife Certification*. The Developer shall not perform Construction Work within SB 40 jurisdictional areas until CPW issues a Programmatic or Formal SB 40 Certification.

18.1.2 If a Programmatic SB 40 Certification is required, the Developer shall prepare and submit to the Department a SB 40 Certification application package for Approval, with all documentation required by the CPW Regional Wildlife Manager.

18.1.3 If the Project requires Formal SB40 Certification, the Developer shall be responsible for preparing the SB40 Certification application package on the behalf of the Department. The Department will Approve the application package and submit it to CPW. Approval of the application package by the Department does not constitute approval by CPW.

18.1.4 In SB 40 jurisdictional areas, trees removed during construction, whether native or nonnative, shall be replaced with native trees at a 1:1 replacement ratio based on a stem count of all trees with a diameter at breast height of two inches or greater. Shrubs removed during construction, whether native or nonnative shall be replaced with native shrubs on a 1:1 ratio based on their pre-construction areal coverage.

18.1.5 Tree and shrub mitigation for SB 40 impacts shall also conform to the requirements set out in Section 14 of Schedule 10 (*Landscaping and Aesthetics*).

19. INTEGRATED NOXIOUS WEED MANAGEMENT PLAN

19.1 General Requirements

19.1.1 The Developer shall take actions as necessary to control all noxious weeds throughout the term of the Construction Period and the Operating Period. The Developer shall implement proactive procedures to stop the continued spread of List B species and to eliminate the occurrences of any List A species.

19.1.2 The Developer shall submit an Integrated Noxious Weed Management Plan (INWMP) to the Department for Acceptance prior to the issuance of NTP2. The INWMP shall be implemented at NTP2 and will include identification of noxious weeds in the area, weed management goals and objectives and preventive and control methods.

19.1.3 The INWMP shall also include a requirement for a monthly Noxious Weed Survey which will be conducted from March through October of each year during the Construction Period. The Developer shall create a Schedule of Planned Noxious Weed Management Activities based on the findings of the Monthly Weed Survey that shall be submitted to the Department for Information.

19.1.4 The Developer shall submit a Noxious Weed Survey and Summary of Treatment Activities Report to the Department for Acceptance for each month beginning with March and continuing through October. The Noxious Weed Survey and Summary of Treatment Activities Report shall include the Weed Survey that was completed during the reporting period and a summary of the treatment activities that where implemented.

19.1.5 The INWMP shall address the control methods (chemical, biological, preventative, etc.) that will be put in place to stop the continued spread of List B species and to eliminate the occurrences of any List A species.

19.1.6 The Developer shall assign a qualified representative to be responsible for implementing the INWMP. This representative shall be directly responsible for weed identification, mapping, scheduling herbicide application, and noxious weed topsoil salvage and herbicide selection. A resume documenting the representative's qualifications shall be included in the Noxious Weed Survey and Summary of Treatment Activities Report.

19.1.7 Noxious weeds observed in and near the construction area at the start of construction will be treated with herbicides or physically removed to prevent seeds blowing into disturbed areas during construction. Noxious weeds identified during construction shall be identified and treated.

19.1.8 Additional requirements of the INWMP include:

a. Initial identification and mapping of the baseline conditions for List A, List B, and List C noxious weed species present on the Site prior to NTP2;

b. Schedule and procedures for mechanical and chemical practices prior to topsoil salvage and earthwork operations. Potential areas of topsoil salvage shall be assessed for presence and abundance of noxious weeds prior to salvage. Topsoil from infested areas shall be treated by spraying, taking the topsoil off-Site, or by burying the topsoil during construction;

c. Noxious weed management practices in sensitive areas (on-Site wetlands and threatened and endangered habitat);

d. Procedures for the inspection and washing of the Developer's vehicles before they are used for construction to ensure they are free of soil and debris capable of transporting noxious weed seeds or roots;

e. Areas of temporary disturbance shall be reclaimed in phases throughout the Project and seeded using a permanent native seed mixture. If areas are complete and permanent seeding cannot occur due to the time of year, mulch and mulch tackifier shall be used for temporary erosion control and weed prevention until seeding can occur;

f. Only certified weed-free mulch and bales shall be used;

g. Weed control will use the principles of integrated pest management to treat target weed species efficiently and effectively by using a combination of two or more management techniques (biological, chemical, mechanical and/or cultural). Weed-control methods shall be selected based on the management goal for the species, the nature of the existing environment and methods recommended by Colorado weed experts. The presence of important wildlife habitat or threatened or endangered species shall be considered when choosing control methods;

h. The Developer shall identify and delineate areas of noxious weed infestations and include written instructions in the INWMP detailing herbicide or other appropriate weed control measures required for weed infestations identified during the monitoring work;

i. Noxious weed management after earthwork operations and stabilizing has been completed shall require chemical and mechanical methods that do not disturb native seeding and mulching areas;

j. Weed-infested staging areas shall not be allowed. Weed-infested staging areas shall be mowed and cleared of noxious weeds and sprayed with the appropriate herbicide, or as referenced in the *Colorado Weed Management Guide*;

k. If imported topsoil is used for any part of the Project, the topsoil shall be inspected and certified noxious weed free.

19.1.9 During the Operating Period; the Noxious Weed Survey, Schedule of Planned Noxious Weed Management Activities, and Noxious Weed Survey and Summary of Treatment Activities Report can be reduced to 3 times per year.

20. VISUAL

The Developer shall comply with the aesthetic Element requirements of the Technical Requirements and Section 14 of Schedule 10 (*Landscaping and Aesthetics*).

21. WATER QUALITY

21.1 General Requirements

21.1.1 The Developer shall employ and utilize a Transportation Erosion Control Supervisor as specified in Section 208 of the CDOT *Standard Specifications*.

21.1.2 The ECWP shall include an organization chart identifying the key personnel responsible for implementing the Developer's water quality compliance activities. The plan shall specifically identify the individuals and positions who shall serve in the roles referenced in Section 208 Erosion Control of the CDOT *Standard Specifications*. The plan shall include a detailed description of the roles that the Developer's Process Control (PC) and the Developer's Independent Quality Control (IQC) programs shall be assigned in the quality control and quality assurance of water quality activities.

21.1.3 The Developer shall determine the specific permits required for the Work. The Developer will be responsible for obtaining and will be the designated entity under all of the water quality permits related to construction activities.

21.1.4 If required, the Developer shall obtain a Substitute Water Supply Plan from the Colorado Division of Water Resources for all temporary or permanent dewatering activities.

22. WETLANDS/WATERS OF THE U.S. AND SECTION 404 PERMIT

22.1 General Requirements

22.1.1 Impacts to jurisdictional wetlands shall not exceed those impacts described in the I-70 East EIS and are shown in the Existing Wetland Delineation provided in Schedule 29 (*Reference Documents*). The Developer shall further minimize impacts to wetlands as the design is finalized to the fullest practicable extent.

22.1.2 The Developer shall obtain a Clean Water Act, Section 404 Permit for impacts to wetlands and waters of the U.S. The Developer shall be responsible for mitigating unavoidable impacts to such wetlands and waters. It is anticipated that a Nationwide Permit 14 (Linear Transportation Projects) will apply to this Project because impacts to jurisdictional wetlands based on the Preferred Alternative are less than the 0.5 acre threshold. The actual Permit requirements are subject to the Developer's design and approval by the U.S. Army Corps of Engineers.

22.1.3 Concurrent with any mitigation requirements mandated by the Section 404 Permit, the Developer shall mitigate for both jurisdictional and non-jurisdictional permanent wetland impacts at a 1:1 ratio per CDOT policy. Mitigation in a wetland mitigation bank located in the South Platte River watershed is acceptable to the Department. Costs for this credit are the responsibility of the Developer. The Developer shall comply with the requirements and special conditions outlined in the Section 404 Permit and 401 Certification.

22.1.4 If wetland impacts exceed the thresholds identified in the 2006 *Memorandum of Agreement between FHWA and CDOT Regarding the Programmatic Approval of Wetland Findings*, the Developer shall submit a Wetland Finding Report for Approval prior to impacting wetlands. A CDOT Functional Assessment of Colorado Wetlands (FACWet) shall be performed if a Wetland Finding is required.

22.1.5 The Developer shall protect any wetlands within the Site or adjacent to the Site that are to remain undisturbed. Protected wetlands shall be fenced and marked with signs (and included on design drawings) to keep Project personnel and equipment out. Water quality BMPs shall be utilized to keep sediment out of any protected wetland.

23. WILDLIFE

23.1 Black-tailed Prairie Dogs

23.1.1 There are existing Black-tailed prairie dog (BTPD) colonies within the Site that could be impacted by construction activities. The CDOT *Impacted Black-tailed Prairie Dog Policy* applies if BTPD colonies are impacted. CPW also regulate certain activities associated with impacts to BTPD.

Local Agencies for the Project may have regulating policies to address BTPD populations, as well. The Developer shall be responsible for complying with applicable Laws associated with BTPD. When there are conflicting policies, the most stringent policy shall be followed.

23.1.2 Prior to conducting any activities that could potentially impact BTPD, the Developer shall submit a BTPD Management Plan for Department Acceptance. This plan will be submitted to Governmental Authorities for approval, as required by their policies. At a minimum, the plan shall comport with the obligations identified in Section 5.13.5 of the FEIS, CRS 35-7-203, and the CDOT *Impacted Black-Tailed Prairie Dog Polic*y.

23.1.3 The plan shall outline the anticipated impacts and how the Developer shall comply with CDOT policies, Local Agency requirements and Environmental Requirements. If BTPDs are relocated or removed during the burrowing owl nesting season (March 15 through October 31), the affected habitat shall be surveyed by a qualified wildlife biologist for the presence of burrowing owls no more than seven Calendar Days prior to initiating construction.

23.2 Migratory Bird Treaty Act

The Developer shall comply with the Migratory Bird Treaty Act (MBTA) at all times. Protection of migratory birds under the MBTA shall be in accordance with Appendix A Project Special Provisions.

23.3 Colorado Butterfly Plant (*Gaura neomexicana*)

The Colorado butterfly plant is one of two federally threatened species that may be found in the Site. Suitable habitat occurs along the South Platte River and Sand Creek, therefore, the Developer shall have a qualified botanist conduct surveys for this species during the flowering season within and adjacent to the areas of disturbance at the South Platte River and Sand Creek prior to the commencement of construction activities in the relevant areas, and in subsequent years for construction areas not impacted as of the survey date. Impacts to these areas shall not occur until surveys are complete and it is confirmed that the species is not present. If Colorado butterfly plants are found, the Developer shall notify the Department immediately.

23.4 Ute Ladies'-tresses Orchid (*Spiranthes diluvialis*)

The Ute ladies'-tresses orchid is a federally threatened plant species. Although biologists think the likelihood is low, the Ute ladies'-tresses orchid has the potential to occur in the study area along the South Platte River and Sand Creek. The Developer shall have a qualified botanist conduct botanical surveys for this species during the flowering season within and adjacent to the areas of disturbance at the South Platte River and along Sand Creek prior to the commencement of construction activities in the relevant areas and in subsequent years for construction areas not impacted as of the survey date. If the plants are present in the areas of disturbance, the Developer will notify the Department and the Department will complete formal consultation with the USFWS prior to construction.

23.5 Burrowing Owl (Athene cunicularia)

High-quality habitat for the State-threatened burrowing owl occurs in association with BTPD colonies that are located throughout the Site area. The Developer shall have a qualified biologist perform burrowing owl surveys following CPW protocols no more than seven Calendar Days prior to the commencement of Construction activities. The survey shall occur during the burrowing owl nesting season (March 15 to October 31) prior to the removal of any BTPD within the Site. If nesting pairs are identified, the Developer shall notify the Department immediately and Construction Work shall not occur within 150 feet of an active nest site between March 15 and October 31, or as determined necessary by a Department wildlife biologist. If a nest becomes occupied after the start of construction activities in any part of the Site, a seasonal buffer zone shall be required during the burrowing owl nesting season to prevent violation of the Migratory Bird Treaty Act.

24. RECOGNIZED HAZARDOUS MATERIALS

24.1 General Requirements

24.1.1 Recognized Hazardous Materials (RHMs) are defined as the presence or suspected presence of Hazardous Substances which may require management and/or disposal. Hazardous Substances may exist on the surface or subsurface, in groundwater or surface water, or structures to be demolished or modified as part of the Construction Work, and may be mixed with soil, water, building materials, and/or other waste materials.

24.1.2 The Developer shall be responsible for all requirements for the management, removal and disposal of RHMs during the Construction Work and the Operating Period.

24.1.3 The Hazardous Materials Technical Report within Attachment H of the FEIS describes the results of an environmental records search for RHMs that was conducted by the Department. Following the records search, the Department conducted limited subsurface and groundwater investigations focused on the Preferred Alternative ground disturbance areas, and documented in the Limited Subsurface and Groundwater Investigation Report as provided in Schedule 29 (*Reference Documents*).

24.1.4 Additionally, Phase I Environmental Site Assessments (ESA)s have been completed by the Department for certain ROW Parcels as indicated in Section 2.2.6 of Schedule 18. Pursuant to Section 2.2.6 of Schedule 18, Phase II ESAs have been completed – or are currently in the process of being completed by the Department – for certain ROW Parcels that have Phase I ESAs that indicate RHM conditions and where a Phase II ESA would better define the extent of RHM issues. Based on the findings presented in completed reports, there is a potential to encounter RHMs throughout the Site. The Developer shall read and utilize the findings and recommendations and requirements presented in these environmental due diligence reports. A list of completed ESAs can be found in Schedule 29 (*Reference Documents*).

24.1.5 Pursuant to Section 2.2.6 of Schedule 18, the Developer shall complete all remaining Phase I ESAs in accordance with ASTM E1527-13 and the EPA standard for conducting all appropriate inquiries, 40 CFR Part 312. The Developer shall be responsible for all work and costs related to completing such Phase I ESAs and shall submit the documents to the Department for Information prior to acquisition of the relevant ROW Parcel. If the Developer deems it prudent for planning, scheduling, or regulatory purposes, the Developer may conduct additional investigations to evaluate RHMs. Such additional investigations shall be the sole cost and responsibility of the Developer.

24.1.6 The Developer is responsible for the management or disposal of RHMs during Construction Work and the Operating Period (e.g., permanent groundwater pumping, treatment and discharge) in accordance with Environmental Law. At the end of the operations and maintenance period, the groundwater dewatering system shall be turned back to the Department according to Schedule 12 (*Handback Requirements*). State and federally regulated facilities are located within the Project. The Developer is responsible for any notification and coordination with appropriate Governmental Authorities, including, but not limited to, CDPHE, EPA, CCD Department of Environmental Health, Division of Oil and Public Safety, and Tri-County Health Department. The Department shall be invited to all meetings and copied in all communications to Government Authorities regarding the management or disposal of RHMs associated with the Project. Furthermore, the Developer shall comply with all Environmental Laws and the CDOT *Standard Specifications*, Section 250, Environmental, Health and Safety Management, and any Project Special Provisions for the identification, management and disposal of the RHMs.

24.1.7 Generator Status and RHM Liability and Cost Recovery

As between the Department and the Developer, the Developer shall be deemed the sole generator under 40 CFR Part 262 with respect to any RHM. The Developer agrees that it shall be identified as the sole generator and that all generator responsibilities as identified by applicable regulations (e.g., hazardous waste characterization, manifests, transport, recordkeeping, etc.) shall be completed by the Developer. To the extent permitted by Law, as between the

Department and the Developer, the Developer shall take and assume sole responsibility and liability for third party claims, causes of action, or other costs and expenses arising out of or resulting from RHM managed or disposed of during Construction Work or the Operating Period, except to the extent such claims, causes of action, or other costs and expenses constitute a Relief Event or a Compensation Event. Further, the Developer may take such actions necessary to preserve its claims against other potentially responsible parties for any such costs pursuant to the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300, provided such actions do not adversely affect the Project Schedule.

24.1.8 The Developer shall comply with all provisions set out in the Approved MMP, SAP, HASP, CDOT Procedures for Hazardous Materials Spills That Occur on State and Federal Highways Within Colorado as a Result of a Highway Transportation Incident for traffic incidents and the Project-specific SPCC and shall maintain documentation of all pertinent certifications of all Subcontractors, which shall be made available upon request by the Department.

24.2 Spills

24.2.1 The Developer shall be responsible for, and shall be required to respond to, any RHM spill event during the Construction Work or any RHM spill event on the infrastructure Elements during the Operating Period.

24.2.2 The Developer shall provide all qualified staff and equipment in accordance with all Environmental Laws. The Developer shall be required to conduct an initial assessment of the affected area and provide the Department with a recommendation on how to proceed as required by the CDOT *Procedures for Hazardous Materials Spills That Occur on State and Federal Highways Within Colorado as a Result of a Highway Transportation Incident* for traffic incidents and the Project-specific Spill Prevention Control and Countermeasure Plan for construction-related spills. The Developer shall further develop a comprehensive plan for the long-term cleanup and monitoring of any Hazardous Substances or fuel spill event as needed. Upon Acceptance of such comprehensive plan and a completion schedule, the Developer shall be responsible for any and all remediation, monitoring and/or related responsibilities related to the event.

24.3 Materials Management Plan

24.3.1 The Developer, working through the Department and the appropriate Governmental Authorities, shall prepare and implement a Materials Management Plan (MMP) for applicable handling, storage and suitable disposal of RHMs. All RHMs shall be tracked throughout their life cycle. The Developer shall manage and dispose of RHMs in accordance with the requirements of this Agreement and all applicable Laws.

24.3.2 The MMP shall identify potential RHMs, their locations, the extent of impact, proposed corrective actions, waste management procedures, avoidance measures, investigation measures, and a contingency plan for addressing unforeseen conditions. The plan shall outline the approach to implementing the MMP and identify required personnel as detailed in item(s) below. In addition to meeting the requirements of Section 250 of the Standard Specifications, the MMP shall demonstrate that the Developer shall manage all RHMs, including soils, groundwater, surface water, and other contaminated substances, in a manner to prevent exposure to proposed Project personnel, the public and the environment, to prevent any contamination of non-contaminated areas, and in compliance with Environmental Laws. The Developer shall be responsible for locating storage facilities and disposal sites for RHMs that are to be removed from the Site. The Developer shall ensure that all requirements of the transporter and the receiving disposal facility and all applicable Law are complied with and are properly documented and the Developer shall not allow RHMs to be spilled or tracked off-site at any time during the Work.

24.3.3 In the MMP, the Developer shall provide provisions to characterize and classify waste into categories, such as:

a. Hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) requiring off-Site disposal and/or treatment;

b. Contaminated soils requiring off-Site disposal;

c. Soils to be stockpiled for further characterization;

d. Soils with concentrations of waste constituents below regulatory concern that can be reused without restriction;

e. Wastewater requiring off-Site disposal and/or treatment;

f. Impacted water to be held for further characterization;

g. ACM discovered during construction or demolition;

h. Lead-based paint associated with Structures, signage, light posts, etc;

i. Waste material to be contained for further characterization; and

j. Contaminated groundwater requiring on-Site treatment or off-site disposal.

24.3.4 The MMP shall include an outline and define the submittal timing for the Monthly Statement of Regulated Hazardous Materials Management and the Recognized Hazardous Materials Management Completion Report. These reports shall include tracking of all RHMs including, but not limited to, their point of origination, location of disposal (on or off-site) and completed waste profiles, manifest forms, and bill-of-lading forms for proper transportation and disposal of materials off-site. This information shall be available at all times for review by the Department.

24.3.5 The MMP shall be submitted for Approval by the Department prior to issuance of NTP2.

24.3.6 The Developer is responsible for all requirements associated with development and implementation (including administration, monitoring, sampling and reporting) of the MMP.

24.4 Sampling and Analysis Plan

24.4.1 The Developer shall prepare a Sampling and Analysis Plan (SAP) to identify and characterize potential RHMs that may be encountered during performance of the Construction Work, and to outline processes for monitoring/screening during construction activities. In addition to complying with Section 250 of the CDOT *Standard Specifications*, the SAP shall include, at a minimum:

a. Data quality objectives;

b. Sample collection procedures (field screening, borehole drilling, monitoring well construction, soil sampling and/or groundwater sampling methods, and decontamination);

c. Quality control;

d. Field equipment calibration procedures/frequency;

e. Quality assurance objectives (data); and

f. Provisions for corrective action, if needed.

24.4.2 The SAP shall be submitted for Approval by the Department prior to issuance of NTP2.

24.5 Health and Safety Plan

24.5.1 The Developer shall have a Certified Industrial Hygienist (CIH) prepare a Health and Safety Plan (HASP) in compliance with 29 CFR 1910.120 or 29 CFR 1926.65, paragraph (b)(4)for Department Approval and distribute the HASP to all employees that could be potentially exposed to RHMs. The HASP shall be displayed or made available on-Site at all times. The Developer shall develop and maintain on-Site all industrial hygiene information, including “right-to-know” information. In addition to meeting the requirements of Section 250 of the CDOT *Standard Specifications*, the Developer shall maintain documentation and promptly provide information to the Department, as requested, regarding potential or actual exposure to workers and/or the public. The Developer shall maintain records of all related incidents and notify the Department and appropriate Governmental Authorities immediately. The HASP shall be considered a “living

document" and, as such, be amended as construction of the Project progresses. The Developer shall be responsible for all costs associated with managing all Occupational Safety and Health Administration (OSHA)-related impacted materials and OSHA safety compliance in accordance with all applicable regulations.

24.5.2 The HASP shall be submitted for Approval by the Department prior to issuance of NTP2.

24.6 Spill Prevention Control Countermeasure Plan

24.6.1 The Developer shall prepare a SPCC Plan for Acceptance by the Department according to 40 CFR 112, and Section 208.06 (Materials Handling and Spill Prevention) of the CDOT *Standard Specifications*. The SPCC shall be considered a "living document" and, as such, be amended as construction of the Project progresses.

24.6.2 The SPCC shall be submitted for Approval by the Department prior to issuance of NTP2.

24.7 Asbestos

24.7.1 Asbestos in Structures

Prior to performing any demolition activities on any part of the Site of any structures, bridges, removal of Utility Service Lines or any other features that may contain asbestos-containing materials (ACMs), the Developer shall determine the presence or absence of ACMs and abate ACMs in accordance with CDPHE Air Pollution Control Commission's Regulation 8 Part B, OSHA and other requirements of Environmental Law. The Developer shall be responsible for all work and costs related to completing asbestos surveys and abatement.

24.7.2 Asbestos in Soils

When soil-disturbing activities are performed in areas with known or suspected asbestos-contaminated soil, or where asbestos-contaminated soils is discovered, the Developer shall conduct inspections and abatement in accordance with CDPHE Section 5.5 of the Solid Waste Regulations, CDOT Asbestos-Contaminated Soil Management Standard Operating procedure, the revised Section 250 Standard Specification, and relevant OSHA, and other requirements of Environmental Law. Costs for all work associated with asbestos-contaminated soils shall be the responsibility of the Developer.

24.8 Lead-Based Paint Survey on Structures

24.8.1 Lead-based paint (LBP) may be present on various components of this project (e.g., bridge girders, railings, light poles, abutments). The Developer shall perform Lead-Based Paint surveys, as necessary, conforming to Section 250.04 of the CDOT *Standard Specifications* (Heavy Metal Based Paint Management) prior to demolition or rehabilitation of all structures that require disturbance, demolition or disposal. The Developer shall avoid sanding, cutting, burning, or otherwise causing the release of lead from paint on selected painted components. OSHA Regulation 1926.62 (29 CFR 1926.62) shall be consulted for worker protection prior to removal of painted components.

24.8.2 If painted metal components are to be removed and recycled, they must be recycled in accordance with Standard Specification 250.04. The recycling facility shall be notified of the potential presence of lead.

24.8.3 The Developer shall provide a method for abating LBP from all structures containing lead to the Department for Acceptance.

24.8.4 The Developer shall comply with all requirements for containing flaked-off paint material and other residue and waste materials that may be generated during removal and transportation of painted structures, including wastewater from power washing operations. Any encapsulate used to treat the lead-based paint shall render the coated paint non-leachable by not exceeding the threshold of 5 milligrams per liter as confirmed by the Toxicity Characteristic Leaching Procedure (TCLP) for lead. The Developer shall properly manage and dispose of solvents, paints, and waste.

24.9 Monthly Statement of Regulated Hazardous Materials Management

The Developer shall submit RHM reports to the Department summarizing all activities associated with the management, removal and disposal of RHMs. The reports shall contain "Tasks/Activities Completed", "Tasks Expected for Next Reporting Quarter", "Percent Complete", and "Issues to be Resolved". The Monthly Statement of Regulated Hazardous Materials Management shall be submitted to the Department monthly for Acceptance.

24.10 Recognized Hazardous Materials Management Completion Report

Within 60-days following Substantial Completion, the Developer shall submit a Completion Report for Acceptance documenting how the MMP was implemented and detailing how RHMs were identified, handled and disposed.

24.11 Other Requirements

24.11.1 The Developer is responsible for any reporting required by Governmental Authorities, including, but not limited to, CDPHE, EPA, City and County of Denver Department of Environmental Health, Division of Oil and Public Safety, and Tri-County Health Department. The Developer shall be responsible for the work and costs associated with this reporting.

24.11.2 The Developer is responsible for contacting CDPHE if groundwater monitoring or supply wells will be disturbed by construction activities to determine the status and any requirements for well protection. Non-operational monitoring and supply wells shall be abandoned in accordance with Colorado Division of Water Resources well-abandonment requirements. The Developer is responsible for all costs associated with protecting in place, relocating or abandoning monitoring or supply wells.

24.11.3 The Developer shall conduct a preliminary survey of any private property or buildings that may be affected by dewatering to establish existing conditions and then shall monitor roadways for any settlement caused by dewatering. The Developer shall repair any damage to roadways, private property, or buildings caused by dewatering operations.

24.12 Required Personnel

24.12.1 The Developer shall designate a RHM Manager who is responsible for implementing the MMP and ensuring the Developer follows all Environmental Requirements applicable to RHM. The RHM Manager shall be responsible for leading monthly meetings with the Department to review the status of RHMs. The RHM Manager shall have at least 10 years of experience managing RHMs and shall report to the EM.

24.12.2 The Developer shall designate a HSO in accordance with subsection 250.03(a) of the CDOT *Standard Specifications*. The HSO shall have a thorough knowledge of all applicable OSHA, EPA, State, and local regulations as they pertain to the protection of the environment and the safety and health of the workers and public.

24.12.3 In addition, in accordance with Subsection 250.03(b), the Developer shall designate a Monitoring Technician (MT) who has completed the 40 hour HAZWOPER and eight hour OSHA Supervisory training. The MT shall be responsible for the identification and monitoring of Hazardous Substances during the Construction Period. The MT shall also be a State and EPA-Certified Asbestos Building Inspector (CABI).

24.12.4 The Developer shall certify that the procedures, health and safety precautions, and methods described in the MMP, SAP and HASP are in accordance with the OSHA and EPA standards and all other applicable Law.

25. ENERGY

The Developer shall implement the energy mitigation measures referenced in the ROD to the fullest extent practicable. The Developer shall submit an update quarterly as part of the ECWP update which documents the Developer's procedures and programs to save energy.

26. DELIVERABLES

At a minimum, the Developer shall submit the following Deliverables to the Department for Information, Acceptance, or Approval in accordance with the specified timeframes:

Table 4 Deliverables

Deliverable	Information, Acceptance or Approval	Schedule
Environmental Compliance Work Plan (ECWP)	Approval	Prior to issuance of NTP2
Environmental Status Report	Acceptance	15 Calendar Days following the end of the reporting period (Monthly during the Design and Construction Periods. Quarterly during the Operating Period)
Mitigation Completion Report	Acceptance	Prior to Project Final Acceptance
Environmental Compliance and Mitigation Training Program	Acceptance	60 Calendar Days following issuance of NTP1
Environmental Compliance and Mitigation Training Program Annual Update and Report	Acceptance	Annually, 30 Days after the end of the reporting period
Air Quality Monitoring, Maintenance, and Mitigation Plan (AQ3MP)	Acceptance	Prior to issuance of NTP2
Proposed Locations of PM-10 Monitors	Acceptance	Two weeks prior to operating the monitor
Environmental Approvals (all)	Information	Per the requirements of Environmental Laws and this Agreement
Migratory Bird Nest Survey	Information	Prior to impacting existing structures or vegetation that may contain active bird nests and prior to specific activities (e.g.,. clearing), consistent with CDOT and CPW guidance and policy
Preliminary Technical Noise Report	Acceptance	Prior to conducting Benefited Receptor Preference Survey
Benefited Receptor Preference Survey supporting material	Approval	14 Calendar Days prior to conducting Benefited Receptor Preference Survey
Final Noise Technical Report	Acceptance	Prior to RFC Documents
Construction Noise Mitigation and Monitoring Plan (CNMMP)	Acceptance	Prior to issuance of NTP2
Paleontological Annual Reports	Acceptance	Annually
Paleontological Summary Report	Acceptance	After earthwork is completed
SB 40 Certification Application Package	Approval	Prior to construction work in SB 40 area

Deliverable	Information, Acceptance or Approval	Schedule
Integrated Noxious Weed Management Plan (INWMP)	Acceptance	Prior to issuance of NTP2
Noxious Weed Survey and Summary of Treatment Activities	Acceptance	Monthly – during Construction Period Three times a year – during Operating Period
Wetland Finding Report (if required)	Approval	Prior to impacting wetlands
BTPD Management Plan	Acceptance	Prior to impacting BTPD
Phase I ESA	Information	Prior to acquisition of the parcel
Materials Management Plan (MMP)	Approval	Prior to issuance of NTP2
Sampling and Analysis Plan (SAP)	Approval	Prior to issuance of NTP2
Health and Safety Plan (HASP)	Approval	Prior to issuance of NTP2
Spill Prevention Control and Countermeasures (SPCC) Plan	Acceptance	Prior to issuance of NTP2
New Environmental Approval	Approval	Prior to conducting Work that has not been approved under the ROD
Monthly Statement of Regulated Hazardous Materials Management	Acceptance	14 Calendar Days after the end of each Month
Recognized Hazardous Materials Management Completion Report	Acceptance	60 Calendar Days after the completion of construction activities
Schedule of Planned Noxious Weed Management Activities	Information	Monthly, within five Calendar Days of the Monthly Weed Survey (March through October)
Noxious Weed Survey and Summary of Treatment Activities Report	Acceptance	Monthly, within 15 Calendar Days of the end of each month (March through October) during Construction. Three times a year during Operations.
Protected Environmental Resources shown in all Plan Sets	Acceptance	To be included with each plan set submittal

27. APPENDICES

Appendix A Project Special Provisions

Appendix A
Project Special Provisions

The following specifications modify and take precedence over the Standard Specifications. The requirements of Schedule 10A (*Applicable Standards and Specifications*) apply to these Project Special Provisions.

PROJECT SPECIAL PROVISIONS

REVISION OF SECTION 240
PROTECTION OF MIGRATORY BIRDS
BIOLOGICAL WORK PERFORMED BY THE DEVELOPER'S BIOLOGIST

Section 240 is hereby added to the Standard Specifications as follows:

DESCRIPTION

240.01 The Developer shall schedule clearing and grubbing operations and Work on structures to avoid taking (pursue, hunt, take, capture or kill; attempt to take, capture, kill or possess) migratory birds protected by the Migratory Bird Treaty Act (MBTA). The Developer shall retain a qualified wildlife biologist for this Project. The wildlife biologist shall have a minimum of three years of experience conducting migratory bird surveys and implementing the requirements of the MBTA. The Developer shall submit documentation of the biologist's education and experience.

The wildlife biologist shall survey the location of each protected nest, bird species, the protection method used, and the date installed. A copy of these records shall be submitted to the Department for acceptance.

(a) *Vegetation Removal.*

1. When possible, vegetation shall be cleared prior to the time when active nests are present. Vegetation removal activities shall be timed to avoid the migratory bird breeding season which begins on April 1 and runs to August 31. All areas scheduled for clearing and grubbing between April 1 and August 31 shall first be surveyed within the Work limits for active migratory bird nests. The Developer's wildlife biologist shall also survey for active migratory bird nests within 50 feet outside work limits. The Developer personnel shall enter areas outside the Right-of-Way in accordance with Section 17.10.6. The Developer shall avoid all active migratory bird nests. The Developer shall avoid the area within 50 feet of the active nests or the area within the distance recommended by the wildlife biologist until all nests within that area have become inactive. Inactive nest removal and other necessary measures shall be incorporated into the Work as follows:

2. Tree and Shrub Removal or Trimming. Tree and shrub removal or trimming shall occur before April 1 or after August 31 if possible. If tree and shrub removal or trimming must occur between April 1 and August 31, a survey for active nests shall be conducted by the wildlife biologist within the seven Calendar Days immediately prior to the beginning of Work in each area of tree and shrub removal or trimming. The survey shall be conducted for each phase of tree and shrub removal or trimming.

    A. If an active nest containing eggs or young birds is found, the tree or shrub containing the active nest shall remain undisturbed and protected until the nest becomes inactive. The nest shall be protected by placing fence (plastic) a minimum distance of 50 feet from each nest to be undisturbed. This buffer dimension may be changed if determined appropriate by the wildlife biologist and Approved by the Department. Work shall not proceed within the fenced buffer area until the young have fledged or the nests have become inactive. If the fence is knocked down or destroyed by the Developer, the Department will suspend the Work, wholly or in part, until the fence is satisfactorily repaired at the Developer'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.

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REVISION OF SECTION 240
PROTECTION OF MIGRATORY BIRDS
BIOLOGICAL WORK PERFORMED BY THE DEVELOPER'S BIOLOGIST

(b) *Surveys*

1. Due to the potential for encountering ground nesting birds' habitat, if Work occurs between April 1 and August 31, the area shall be surveyed by the Developer's wildlife biologist within the seven [Calendar Days] immediately prior to ground disturbing activities.

2. The wildlife biologist shall conduct dusk and dawn surveys of Bald Eagle roosts within seven [Calendar Days] prior to the start of any Construction during the winter season, November 15 to March15. If a Bald Eagle roost is identified, Construction activity shall not proceed within 0.25 mile of active nocturnal roost sites between November 15 and March 15.

3. The wildlife biologist shall conduct raptor nest surveys within 0.5 mile of the Site prior to the start of Construction and prior to each Construction phase. This survey can be done with binoculars. If Construction activities are located within the CPW recommended buffer zone for specific raptors, "NO WORK" zones shall be established around active sites during Construction according to the CPW standards or as recommended by the wildlife biologist in consultation with the CPW. The "NO WORK" zone shall be marked with either fencing or signing. Work shall not proceed within a "NO WORK" zone until the wildlife biologist has determined that the young have fledged or the nest is unoccupied.

(c) *Work on structures*

1. The Developer shall prosecute Work on structures in a manner that does not result in a taking of migratory birds protected by the Migratory Bird Treaty Act (MBTA). The Developer shall not prosecute the Work on structures during the primary breeding season, April 1 through August 31, unless he takes the following actions:

   A. The Developer shall remove existing nests prior to April 1. If this Agreement is not awarded prior to April 1 and the Department has removed existing nests, then the monitoring of nest building shall become the Developer's responsibility upon NTP1.

   B. During the time that the birds are trying to build or occupy their nests, between April 1 and August 31, the Developer shall monitor the structures at least once every three [Calendar Days] for any nesting activity.

   C. If the birds have started to build any nests, they shall be removed before the nest is completed. Water shall not be used to remove the nests if nests are located within 50 feet of any surface waters.

   D. Installation of netting may be used to prevent nest building. The netting shall be monitored and repaired or replaced as needed. Netting shall consist of a mesh with openings that are ¾ inch by ¾ inch or less.

2. If an active nest become established, i.e., there are eggs or young in the nest, all Work that could result in abandonment or destruction of the nest shall be avoided until the young have fledged or the nest is unoccupied as determined by the wildlife biologist and Approved by the

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REVISION OF SECTION 240
PROTECTION OF MIGRATORY BIRDS
BIOLOGICAL WORK PERFORMED BY THE DEVELOPER'S BIOLOGIST

Department. The Developer shall prevent construction activity from displacing birds after they have laid their eggs and before the young have fledged.

3. If the Project continues into the following spring, this cycle shall be repeated. When Work on the structure is complete, the Developer shall remove and properly dispose of netting used on the structure.

(d) *Taking of a Migratory Bird*

The taking of a migratory bird shall be reported to the Department. The Developer shall be responsible for all penalties levied by the USFWS for the taking of a migratory bird.

(e) *Permission to Enter Property*

CDOT Form 730, *Permission to Enter Property*, shall be obtained to facilitate the wildlife biologist's ground surveys within adjacent property within 50 ft. of Work limits, where the Developer's wildlife biologist has determined ground nesting bird habitat may be present. If Permission to Enter Property is denied by a property owner, record the denial and place the record in the Project file to document that due diligence was pursued.

Schedule 18
Right-of-Way

1. GENERAL

1.1 Possession of the Right-of-Way

1.1.1 The Department shall provide Developer with Possession of each ROW Parcel, and any Additional ROW Parcels, pursuant to Section 7.2.1.

1.1.2 Developer shall be responsible for acquiring rights to any Temporary Properties (subject to the terms of this Schedule 18 with respect to any Temporary Easements) and all Permit Areas (subject to Section 8.4).

1.1.3 Except to the extent expressly provided in this Agreement, including in this Schedule 18, the Department shall not have any obligation, liability or responsibility with respect to the acquisition, Property Management, maintenance or disposition of, or otherwise with respect to any part of the Site.

1.2 Early Access and Permission to Enter

1.2.1 Prior to the Project License Start Date for any ROW Parcel or any Additional ROW Parcel, Developer may from time to time submit requests to the Department to visit and inspect such parcel for purposes of facilitating, and preparing for, its performance of the Work. The Department may require that such request be submitted using a Permission to Enter Property Form. Any such request shall be subject to the Department's Acceptance.

1.2.2 Developer may also secure Department permission to enter any other property for surveying, non-intrusive environmental investigation and appraisal purposes, and no other purposes, (a) to which the Department is entitled to grant such permission to enter, and (b) that is not or will not be within a ROW Parcel or an Additional ROW Parcel, in each case using a Permission to Enter Property Form. Any such request shall be subject to the Department's Approval.

1.2.3 Developer shall submit any request to enter property for which it requires Department's permission to enter pursuant to Sections 1.2.1 and 1.2.2 of this Schedule 18 no later than five Working Days prior to the proposed date of entry. The Department's Acceptance or Approval, as applicable, of such request shall be subject to such conditions as the Department may require, including payment of all the Department's associated costs and Developer having provided (or having procured that a Subcontractor has provided) satisfactory evidence to the Department that there is in place all necessary insurance coverage required by the Department in connection with such access and the activities Developer proposes to conduct during such early access.

1.2.4 Developer shall be solely responsible for any and all damages and claims resulting from its access to any property pursuant to Sections 1.2.1 or 1.2.2 of this Schedule 18 and any activities performed during such access.

1.3 Partial Acquisitions

1.3.1 Set out in Appendix A to this Schedule 18 are the ROW Parcels that the Department will acquire. These include certain partial acquisitions from the total ownership of properties depicted in the Right-of-Way Exhibits in Schedule 10B Contract Drawings. The Right-of-Way Exhibits for private ownerships and the Onsite Outfall System in Schedule 10B Contract Drawings depict entire ownerships of properties from which a partial acquisition will be needed. The maximum entire ownership has been identified simply for identification purposes and the Department's provided partial acquisition shall be the construction limits identified in the Reference Design.

1.3.2 With respect to such partial acquisitions, the following will apply:

a. The Department will be responsible for acquiring partial acquisitions in accordance with the existing construction limits provided in the current Reference Design. According to the design requirements of CCD, the right-of-way boundary of the maximum partial acquisition will be 6 inches from the back of the sidewalk.

b. In the event:

i. any differences between Developer's design and the Reference Design;

ii. differences between the design, construction, operations and/or maintenance means and methods Developer chooses for any portion of the Project and those set out, referred to or contemplated in any Governmental Approval (including, for certainty, any Department Provided Approval) or the application for the same; and/or

iii. the prior acquisition of any Additional ROW Parcel, Developer-risk Permit Area or any Temporary Property Rights,

require the acquisition of additional property, such property shall be acquired by Developer as Additional ROW Parcels, Developer-risk Permit Areas and/or Temporary Property Rights.

c. If Developer elects to have the Department obtain partial acquisitions that are within (but, for certainty, not exceeding) the construction limits in the current Reference Design, Developer shall give the Department written notice to commence partial acquisitions. Such written notice must be accompanied by a CAD file of the design and proposed ROW line work.

1.4 ROW Manager

A ROW Manager shall be retained by Developer if Approval of Additional Right-of-Way or Temporary Easement acquisition by Developer is requested of the Department pursuant to Section 3.4 of this Schedule 18. Developer's ROW Manager shall be responsible for all of Developer's acquisition and relocation coordination and compliance requirements pursuant to Sections 3.4 and 3.5 of this Schedule 18. Developer's ROW Manager shall be qualified and Approved by the Department for both acquisition and relocation activities.

1.5 Tracking of Developer Responsibilities

1.5.1 For Additional Right-of-Way and Temporary Easement acquisitions and Property Management Activities that are the responsibility of Developer pursuant to this Schedule 18, Developer must establish, and provide the Department with, a project tracking and Quality Control/Quality Assurance system, the form and substance of which is subject to the Department's Acceptance, provided that, at Developer's discretion, such system may be either in the form of specialized spreadsheets or a proprietary software program.

1.5.2 The project tracking and Quality Control/Quality Assurance system must show the status of field survey, ROW plans, appraisal and appraisal review, acquisition, relocation, property management and Quality Control/Quality Assurance status for all ROW Parcels, Additional ROW Parcels and Temporary Easements.

2. PROPERTY MANAGEMENT

2.1 Property Management – General

2.1.1 Property Management activities include responsibility for acquired properties after acquisition and relocation has been completed and possession has been obtained, as such responsibilities are described in Chapter 7 of the CDOT Right of Way Manual and including:

a. Regular inspection and securing of properties to prevent and/or detect damage or unauthorized occupancy;

b. Installation of security fencing;

c. Preparing environmental building inventory reports;

d. Testing for Hazardous Substances;

e. Disconnecting Utilities;

f. Boarding-up properties;

g. Removal or remediation of Hazardous Substances above the land surface;

h. Removal or remediation of subsurface Hazardous Substances;

i. Preparation of a Stormwater Management Plan ("SWMP");

j. Installation of the SWMP improvements as required by the SWMP;

k. Building or other structural demolition; and

l. Miscellaneous maintenance if temporarily necessary,

(all such activities and responsibilities, "Property Management").

2.2 Property Management Activities and Responsibilities

2.2.1 Subject to Section 2.2.2 of this Schedule 18:

a. Developer shall be responsible for all Property Management activities for:

i. all ROW Parcels and any Additional ROW Parcels, with effect from the applicable Project License Start Date; and

ii. any Temporary Easements, with effect from the Calendar Day on which Developer first has the benefit of such easement; and

b. to the extent Chapter 7 of the CDOT Right of Way Manual identifies CDOT as the responsible party for specified Property Management activities, Developer shall take the place of CDOT in performing, and being fully responsible for, such activities to the extent Developer is responsible for such activities pursuant to Section 2.1.1a of this Schedule 18.

2.2.2 To help expedite the early availability to Developer of properties that the Department intends to acquire before Developer has received NTP1, the Department will assist Developer by undertaking, subject to Section 2.2.3 of this Schedule 18, Property Management activities for those parcels that are identified in Appendix A to this Schedule 18 as being subject to Department Property Management. The Department shall complete Property Management activities for which it is responsible pursuant to this Section 2.2 no later than the Project License Start Date with respect to each parcel.

2.2.3 The Department's obligations under Section 2.2.2 of this Schedule 18 shall not include:

a. any responsibility or liability for removal or remediation of any subsurface storage tanks or other subsurface Hazardous Substances; or

b. any Property Management activities that are required as a result of:

i. any differences between Developer's design and the Reference Design;

ii. differences between the design, construction, operations and/or maintenance means and methods Developer chooses for any portion of the Project and those set out, referred to or contemplated in any Governmental Approval (including, for certainty, any Department Provided Approval) or the application for the same; and/or

iii. the acquisition of any Additional ROW Parcel, Developer-risk Permit Area or any Temporary Property Rights.

2.2.4 For acquisitions by Developer, Developer shall prepare and submit to the Department for Acceptance its own SWMP plans. Developer shall obtain the appropriate permit from the Colorado Department of Public Health and Environment ("CDPHE") and/or CCD for all SWMP improvements and install and maintain such improvements for the entire term of the Construction Work.

2.2.5 Developer shall also prepare and submit to the Department for Acceptance a Property Management Plan. The Property Management Plan shall establish administrative and technical means for Property Management, including the security, Hazardous Substances assessment, demolition, debris removal, site clearing, storm water management improvements, and clean-up of building structures and property improvements acquired as part of any ROW Parcel, Additional ROW Parcel or Temporary Easement. The Property Management Plan shall specify how Developer's Property Management activities will conform to Chapter 7, Property Management, of the CDOT Right of Way Manual. The Property Management Plan shall be submitted to the Department for Acceptance no later than 60 Calendar Days after the date of issuance of NTP1. In addition, when Developer receives Approval from the Department to acquire Additional ROW Parcels or Temporary Easements pursuant to Section 3.4 of this Schedule 18, the Property Management Plan will be updated by Developer, subject to the Department's Acceptance, to include any such Additional ROW Parcels and/or Temporary Easements in the plan.

2.2.6 Environmental Site Assessments

a. Prior to the applicable Project License Start Date, the Department shall obtain Phase I environmental assessments for all ROW Parcels set out in Appendix A to this Schedule 18 for which the Department will undertake Property Management responsibilities.

b. In addition, the Department shall obtain Phase I environmental assessments for the following specific properties: AP-43, AP-44, AP-45, AP-47, AP-48, AP-52, AP-67, AP-92, AP-28, AP-72, AP-78, AP-79, AP-83, AP-102, AP-109, AP-122, AP-184, AP-185, PE-26, TE-26, PE-26I, PE-26J, AP-86, AP-86A, AP-86B, AP-93, AP-93A, RW-89, TE-89, RW-90, TE-90, RW-90A, TE-90, TE-191, TE-192, RW-136, RW-136a, RW-136b, and AP-139, each as identified in Appendix A to this Schedule 18.

c. With the exception of the specific assessments referenced in Sections 2.2.6a and 2.2.6b of this Schedule 18, Developer shall be responsible to obtain Phase I environmental assessments for all other ROW Parcels.

d. In cases where the Phase I environmental assessment indicates a need for Phase II environmental testing, the Party who obtained the Phase I environmental assessment will conduct the identified Phase II environmental testing.

2.3 Property Management – Demolition

2.3.1 Demolition by Developer as part of its Property Management activities or the Construction Work shall not commence until:

a. Developer has Possession of the property in accordance with Section 7.2.1.b; and

b. all environmental building inventories and environmental testing of any buildings or other structures to be demolished has been completed, all abatement of identified Hazardous Substances in and on such buildings or structures is completed, improvements have been boarded up, all Utilities have been disconnected, all SWMP improvements are in place, and all necessary approvals and permits have been obtained from the City and County of Denver and/or the Colorado Department of Public Health and Environment (CDPHE), as applicable, all in accordance with the Environmental Requirements.

2.3.2 All such demolition must be completed prior to commencing any Construction Work (other than preparatory activities for such demolition, the demolition itself, and non-intrusive inspections of the relevant buildings or structures) on the property. If such demolition is not immediately completed for any reason, Developer shall be responsible for all ongoing Property Management for any existing improvements until demolition is completed.

2.3.3 Developer shall, in accordance with Law and the Environmental Requirements, properly abate, remove and/or dispose of, at its own cost, all regulated asbestos containing material, all Universal and other types of hazardous waste, and any other regulated material other than solid waste prior to demolition of any buildings or other structures. Developer shall also obtain all permits or other approval documents required by Governmental Authorities including, but not limited to, a

Demolition Plan Accepted by the Department in accordance with the Occupational Health and Safety Administration (OSHA) demolition regulations 1926.850 prior to demolition of any buildings or other structures. Such documentation shall be submitted to the Department for Acceptance at least 15 Working Days prior to proposed demolition.

3. ADDITIONAL RIGHT-OF-WAY AND TEMPORARY EASEMENTS

3.1 Acquisition and Relocation Standards

3.1.1 To the extent permitted by this Schedule 18, all activities related to acquisition of Additional ROW Parcels and Temporary Easements, and related relocations, shall be performed by Developer in accordance with Law and applicable procedures, including:

a. The Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (the "Uniform Act"), including regulations promulgated pursuant to such Act, which appear at 49 CFR Part 24;

b. Right-of-Way Requirements for Design/Build Projects, 23 CFR 710.313;

c. The Colorado Relocation Assistance and Land Acquisition Policies Act, 24-56-101, et seq., C.R.S.;

d. The Colorado Eminent Domain Act, Section 38-1-101, et seq., C.R.S.; and

e. The most recent CDOT Right of Way Manual.

3.1.2 In relation to any acquisition of Additional ROW Parcels and Temporary Easements, and related relocations, all appraisal, acquisition, negotiation, and relocation activities shall be performed by consultants that are pre-approved by the Department, subject to the Department's Acceptance of Developer's support documentation for such activities.

3.2 Acquisition of Right of Way by the Department

3.2.1 In the event Developer requests Additional Right-of-Way to accommodate its design, and the Department Approves such request, Developer shall be responsible for such acquisitions. All Additional Right-of-Way shall be held or acquired pursuant to Section 7.3.1.

3.2.2 Set out in Appendix A to this Schedule 18 are the ROW Parcels that the Department will acquire. Included therein are all known ROW Parcels anticipated to be required within the construction limits for the construction of the current Reference Design, exclusive of Temporary Property which is the responsibility of Developer to acquire. The ROW Parcels that the Department will acquire include:

a. Selected total acquisitions of residential and commercial properties;

b. Partial acquisitions (including acquisitions in fee, or for permanent or temporary easements);

c. Acquisitions of fee interests, permits, permanent easements, and/or temporary easement acquisitions from the Union Pacific Railroad (UPRR), Denver Rock Island Railroad (DRIR), Colorado Eastern, and Burlington Northern Railroad (BNSF), including properties adjoining the BNSF tracks, including Weakland Investments LLC, Manna Pro West, and Farmers Marketing Association; and

d. Right-of-way interests from the City of Denver.

3.3 General Requirements Before Developer Can Initiate Acquisition Of Additional Right-of-Way

If Developer identifies any:

a. Additional ROW Parcel that is permanently needed to construct or maintain the Project; or

b. Additional rights beyond those which Developer otherwise has or will have under the Project License in relation to any part of the Right-of-Way or any previously acquired Additional ROW Parcel,

then it shall only take any action to secure or acquire access to or any interest in any such Additional ROW Parcel or additional rights with the Department's Approval and also:

c. Ensuring that any Additional ROW Parcels or additional rights shall be held or acquired, as applicable, pursuant to Section 7.3.1;

d. Paying or committing to pay all the Department's and the State's costs and expenses, provided that, in paying all such costs and expenses, Developer is not acquiring, and shall not be deemed to be acquiring, any interest in real property for Developer; and

e. Agreeing to bear the risk of any time and cost impacts to the Work related to securing or acquiring access to or any interest in such Additional ROW Parcel or additional rights.

3.4 Request for Additional Right-of-Way and Temporary Easements

3.4.1 In accordance with 23 CFR §710.313(d)(1)(i), Developer must submit written acquisition and relocation procedures to the Department for Approval prior to commencing right-of-way activities for the acquisition of Additional ROW Parcels and Temporary Easements. These procedures shall contain a prioritized appraisal, acquisition and relocation strategy as well as check points for the Department's Acceptance, such as the Department's determination of just compensation, replacement housing payment calculations, replacement housing payment and moving cost claims, appraisals, administrative and stipulated settlements that exceed determined thresholds based on a risk management analysis, etc.

3.4.2 Each such request shall include the following documentation:

a. Copies of Developer's latest design files.

b. Identification of each Additional ROW Parcel, identification of each Additional ROW Parcel as being a total acquisition or partial acquisition either in fee or for a permanent easement, or Temporary Easement (where an illustration of each parcel superimposed on an aerial photograph with approximate area of the parcel will be sufficient), and an explanation of a justification for its need; and

c. a preliminary cost estimate for each parcel that includes separate values for land, improvements, damages or benefits (if any), relocation (if applicable), and survey, Right of Way Plan preparation, appraisal, and acquisition costs. This information is not applicable to, or necessary for, Permits.

3.5 Acquisitions of Additional Right-of-Way and Temporary Easements

3.5.1 If written Approval is obtained from the Department pursuant to Section 3.4 of this Schedule 18, Developer may begin the process for the acquisition of the proposed Additional ROW Parcel and/or Temporary Easement at its own cost and expense. Such process includes the activities required to be performed pursuant to this Section 3.5 and as set out in Appendix B to this Schedule 18.

3.5.2 All aspects of Developer's process for property acquisitions under this Schedule 18 shall be conducted in compliance with the CDOT Right of Way Manual, including Right of Way Plan preparation, appraisal and acquisition. The appraisal review function pursuant to the CDOT Right of Way Manual, including the issuance of a Determination of Fair Market Value (FMV), is solely the Department's responsibility. Upon issuance of an FMV by the Department, in its discretion, Developer may proceed with acquisition negotiations and relocation, if needed. For any fee parcels acquired as Additional Right-of-Way, Developer shall obtain and provide appropriate release documents for any encumbrances affecting the acquisition parcels, including but not limited to releases of deeds of trust, mortgages, easements, and liens. If liens or encumbrances affect permanent easement parcels being acquired as Additional Right-of-Way, the Department will be notified of such liens and encumbrances and Developer will be required to take the action

requested by the Department with respect to such liens and encumbrances, including subordination or release of the liens and encumbrances. An appropriate environmental clearance, as specified in Schedule 17 (*Environmental Requirements*), shall be required as a prerequisite for Approval of Right of Way Plans for any Additional ROW Parcel.

3.5.3 If the proposed Additional ROW Parcel or Temporary Easement is to be acquired from a landowner with whom the Department has an unsettled condemnation case, Developer shall ensure that, to the extent possible, the same appraiser that prepared the appraisal for the Department's condemnation case shall value the proposed Additional ROW Parcel or Temporary Easement. The Department is responsible to review such additional appraisal and issue a FMV in its discretion. No offer can be made to such property owner until such FMV has been issued. Developer must obtain the Approval of the Department's ROW Manager of certain administrative settlements as described in Appendix B to this Schedule 18. Administrative settlements are settlements over the amount of the Department's Approved offer to purchase that are made to the landowner.

3.5.4 If authorization is obtained from the Department for the purchase of any Additional ROW Parcel and/or Temporary Easement, Developer's ROW Manager shall meet with the Department, every two weeks, to review the status of the acquisition and relocations and confirm that Quality Control/Quality Assurance measures have been followed. Such periodic reviews will continue until the completion of the acquisition, any related relocation, and Department's Approval of the acquisition and relocations. At such periodic status meetings, Developer shall provide the Department with up-to-date reports from Developer's tracking and Quality Control / Quality Assurance system as established pursuant to Section 1.5 of this Schedule 18 on the status of ROW plan preparation, appraisal and appraisal review, acquisition, relocation and property management activities.

3.6 Relocation

3.6.1 For Additional ROW Parcels and any Temporary Easements that may be necessary for total and partial acquisitions, either in fee or for permanent easement, acquired by Developer pursuant to this Schedule 18, Developer shall relocate any occupants and personal property in accordance with the Uniform Act and the CDOT Right of Way Manual.

3.6.2 If the acquisition of any Additional ROW Parcel or Temporary Easement requires occupant or personal property relocation, such relocation shall be conducted in compliance with Chapter 5 of the CDOT Right of Way Manual. Developer shall also comply with the requirements of 23 CFR §710.313(d)(1)(i) as well as 23 CFR §710.313(d)(1)(ii), which specifies that Developer's written relocation plan must provide reasonable time frames for the orderly relocation of residents and businesses as provided at 49 CFR §24.205. These time frames will be based on best estimates of the time it will take to acquire such Additional ROW Parcel or Temporary Easement and relocate families in accordance with certain legal requirements and time frames, which may not be violated. Accordingly, the time frame estimates in Developer's relocation plan for the acquisition shall not be compressed in the event that other necessary actions preceding acquisition miss their assigned due dates.

3.6.3 Without limiting Developer's obligations to comply with Chapter 5 of the CDOT Right of Way and 23 CFR §710.313(d), Developer shall follow the procedures set out in Appendix C *(Steps to be followed by Developer in the Relocation Process)* to this Schedule 18 with respect to any occupant or personal property relocation conducted in connection with any acquisition under Section 3.4 of this Schedule 18.

3.7 Condemnation

3.7.1 If Developer cannot reach an agreement with a landowner for the acquisition of an Additional ROW Parcel or a Temporary Easement, Developer may submit in writing a request for Approval from the Department that it acquire the Additional ROW Parcel or Temporary Easement through condemnation proceedings by the Department. Any exercise by the Department of its condemnation rights shall be in Department's discretion. If the Department agrees to exercise

such rights, the Colorado Attorney General's Office will file and prosecute all condemnations needed for any such acquisition.

3.7.2 Any request by Developer pursuant to Section 3.7.1 of this Schedule 18, shall include the submission to the Department for Approval of a properly completed "Condemnation Memorandum" and "Check List Form" in accordance with the instructions contained in the CDOT Right of Way Manual. The condemnation request shall include a certified check payable to the Clerk of the District Court of the appropriate county in the amount of any required condemnation filing fee and the determination of fair market value or value finding.

3.7.3 Developer shall work with the Department to establish a realistic schedule for filing condemnations, and setting and holding immediate possession hearings, which schedule must be Approved by the Department. If a settlement is negotiated with a property owner after the filing of a condemnation, Developer will be consulted on the settlement, provided that the Department shall have discretion to decide whether to Accept the settlement. If a settlement is Accepted by the Department, Developer shall pay the full amount of the settlement. If a valuation trial is held, Developer shall be responsible for payment of the full amount of the valuation trial award, including, if any, all interest, costs and attorneys' fees per CRS 38-1-122, expert witness fees, court reporter, compensation for commission members, court costs, and any other associated costs not identified herein. The Department may require Developer to provide personnel for pre-trial and court testimony for any condemnation request made by it pursuant to this Section 3.6.

3.7.4 Notwithstanding the foregoing, Developer does not and shall not have any power to file or prosecute condemnations or otherwise exercise any power of eminent domain, and neither the Enterprises nor the Department shall have any obligation to exercise, or to seek or secure the exercise, by any other Governmental Authority (including the State Attorney General's Office) of the same.

3.7.5 If there are any time delays as a result of condemnation proceedings, regardless of whether the Department or Developer was responsible for the particular acquisition, all costs and schedule implications associated with such time delays shall be borne by Developer.

3.8 Developer Possession of Acquired Properties

No later than five Working Days prior to the tender of payment to the property owner of the acquisition price in respect of any Additional ROW Parcel or Temporary Easement, Developer shall submit for the Department's Acceptance a complete parcel acquisition file, which shall include copies of offer letters, FMV determinations or value findings, fully executed easement documents and/or agreements, the negotiator's signed diary, a statement signed by the property owner acknowledging receipt of payment in full and, if relocation was applicable, all required relocation forms. The submittal of a parcel acquisition file shall also include a confirmation that a Quality Control/Quality Assurance review was completed on the file before submittal to the Department. Developer shall not access or take possession of any Additional ROW Parcel or Temporary Easement until the Department provides written authorization.

3.9 Delegations to Department

3.9.1 Notwithstanding any other provision of this Schedule 18, and subject always to compliance with Law, Developer and Department may, in their individual discretion, agree that the Department shall perform, at Developer's cost and expense, any of Developer's obligations under this Schedule 18 with respect to Additional ROW Parcel and Temporary Easement acquisition activities, including Right of Way Plan preparation, appraisal, acquisition, and relocation activities.

3.9.2 If the Parties agree that the Department shall undertake any such Additional ROW Parcel and Temporary Easement activities on Developer's behalf, the Department will provide Developer with an estimated cost to perform the work and anticipated approximate delivery schedule. Developer shall be responsible for any increased costs that may result from a delay in obtaining possession and completion of relocation for any Additional ROW Parcel or Temporary Easement acquired by the Department at the request of Developer pursuant to this Section 3.9.

3.9.3 Notwithstanding the foregoing, in the event that the Department undertakes any activities on behalf of Developer pursuant to this Section 3.9, Developer shall remain responsible for all Property Management activities in relation to any relevant Additional ROW Parcels or Temporary Easements.

3.10 Reinstatement

At the applicable Project License End Date, each ROW Parcel, Additional ROW Parcel and Temporary Easement shall be returned by Developer to the owner or interest holder in the condition required pursuant to the Technical Requirements, and otherwise in the same condition it was in prior to taking possession (after taking into account required Property Management activities). Developer shall, at its sole cost and expense, repair and/or replace or restore any damage to such properties that may occur as a result of Developer's occupancy, to a condition reasonably equal to that existing prior to the damage. Restoration may include repair, replacing in kind, rebuilding, or replanting. Such restoration must be completed by the Project License End Date with respect to the relevant property.

4. ACCESS PERMITS

4.1 Developer to become member of Notification Association

Developer shall become a member of the applicable notification association (as defined in CRS 9-1.5) for the geographical area of the Project.

4.2 Operation of the permitting procedure

4.2.1 The Department will ensure that, in the operation of its procedure for issuing Access Permits in relation to the Project, CDOT will act pursuant to this Section 4.

4.2.2 The Department will promptly notify Developer of any application for an Access Permit that it receives and provide a copy of the application and all supporting documentation and will consult with Developer in relation to the issue of the Access Permit.

4.2.3 The Department will impose a special condition on each Access Permit in substantially the following terms:

a. *Permittee shall coordinate with Developer of the Project for work that encroaches on the highway managed lanes, and traffic control plans are to be reviewed and accepted by Developer before construction.*

b. *Permittee shall coordinate with the following Developer representative:*

i. *Name*

ii. *Address*

iii. *Phone*

c. *Any indemnification requirement contained in the permit's standard or other special provisions shall be amended to read as follows:*

d. *To the extent authorized by law, Permittee hereby assumes, releases, and agrees to indemnify, defend, protect, and save the State of Colorado and Developer from and against any loss and/or damages to the property of the State of Colorado, Developer, third parties or the Permittee's facilities, and all loss and/or damage on account of injury to or death of any person whomsoever, arising at any time, caused by or growing out of the occupation of Colorado State Highway rights of way by Permittee's facilities or any part thereof, including but not limited to installation, adjustment, relocation, maintenance or operation, or removal of existing facilities, unless such loss and/or damage arises from the sole negligence of willful conduct of the State of Colorado, Developer or their employees or agents.*

e. *Permittee shall also name Developer as an additional insured on their Commercial General Liability, Auto Liability, Pollution Legal Liability and Umbrella or Excess Liability*

insurance policies in addition to naming the Department as an additional insured as required by Standard Term 3.H.

4.2.4 The Department shall use its Reasonable Efforts to address any reasonable requirements of Developer, including in relation to scheduling, in relation to any other special condition to be included in the Access Permit.

4.2.5 For certainty, it shall be the responsibility of Developer, and not the Department, to verify to its satisfaction that any Person exercising a right of access pursuant to an Access Permit has complied with its obligation to have insurance cover as required by the special condition referred to in Section 4.2.3 of this Schedule 18.[1]

5. MISCELLANEOUS

5.1 Prohibition Against Coercion, Impairment of Safety, and Inconvenience of Displaced Occupants Still in Occupancy

5.1.1 Developer acknowledges and agrees that, in compliance with 23 CFR §710.313(d)(3), the Department may establish hold off zones around occupied properties whose occupants are being displaced by any ROW Parcel, Additional ROW Parcel or Temporary Easement acquisition, but have not vacated the premises, and that such activities shall not themselves constitute a Supervening Event. If such zones are established, no construction-related activity will be allowed within the hold off zone until the Department provides written authorization.

5.1.2 Developer agrees to comply with, and take all necessary steps to ensure that Department is able to comply with, 23 CFR §710.313(d)(4)-(6) with respect to any ROW Parcel, Additional ROW Parcel or Temporary Easement being acquired pursuant to this Schedule 18.

6. DELIVERABLES

At a minimum, Developer shall submit the following to the Department for Information, Acceptance, or Approval as indicated in accordance with the specified time frames.

[1] **Note to Draft**: Is it appropriate to require Developer to conduct this check? Would this be consistent with CDOT usual practice? CDOT will need to check the insurance cover is in place for its own benefit, so would it not just check that it also includes Developer as an additional insured, rather than having to get Developer involved in the process?

Table 1 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Property Management Plan	Acceptance	60 Calendar Days after issuance of NTP1
Certification of review of CDOT Right of Way Manual	Information	Condition to the issuance of NTP1
Parcel acquisition files	Acceptance	No later than five Working Days prior to the tender of payment to land owner
Condemnation memorandum and check list form	Approval	Concurrent with the request to the Department for property condemnation
Written notification by Developer to commence partial acquisitions accompanied by CAD file of the design and proposed ROW line work	Information	Per Project Schedule
Written request by Developer to acquire ROW Parcels that require prior notice as indicated in Appendix A	Approval	By [ ][2], provided that any failure by Developer to provide notice by such date shall be considered a waiver of its right to request such acquisition
Written request by Developer to acquire Additional ROW Parcel, including required accompanying documents	Approval	As required
Submit written acquisition and relocation procedures	Acceptance	Concurrent with Developer request to acquire Additional ROW Parcel
Permission to Enter Property Form	Acceptance	At least five Working Days prior to entering private property
Asbestos and lead based paint inspection	Acceptance	15 Working Days prior to demolition
Appraisals	Acceptance	Prior to issuance of FMV by Department
Value Findings	Approval	Prior to offer being made
Relocation Plan	Approval	With request for additional ROW
Administrative settlement	Approval	Prior to execution of MOA

7. APPENDICES

Appendix A Right-of-Way Schedule

Appendix B Steps to be followed by Developer in the Right-of-Way Acquisition Process

Appendix C Steps to be followed by Developer in the Relocation Process

[2] Note to Proposers: Date to be provided in a subsequent Addendum.

Appendix A

Right-of-Way Schedule

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
All ROW Interests from CCD	Brighton Boulevard to Quebec St.	DEPT – ACQ DEV – PM	CCD	NTP2
AP-5 and AP-5A	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Ringsby Terminal Inc. (previous)	NTP2
AP-11	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Gene Levy (previous)	NTP2
AP-17	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Tedrow Investments LLC (previous)	NTP2
AP-18	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Vibha Sharma (previous)	NTP2
AP-30	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Earl Brown (previous)	NTP2
AP-31	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Victoria & William Burke (previous)	NTP2
AP-41	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Karl C De Baca (previous)	NTP2
AP-54	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Drew Brennan Arnold (previous)	NTP2
AP-57	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Jose Guzman (previous)	NTP2
AP-58	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Mark Escobedo (previous)	NTP2
AP-59	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Adam Van Patten (previous)	NTP2
AP-76	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Todd A. and Cherish Wells (previous)	NTP2
AP-88	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Denver Rescue Mission (previous)	3/31/17
AP-6	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	4623 High Street Trust (previous)	NTP2
AP-19	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Hipolito Diaz-Luevano (previous)	NTP2
AP-20	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Larry and Malinda Kowalis (previous)	NTP2
AP-22	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	First Securities Corp. (previous)	NTP2
AP-23	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Ventura and Maria Reyes (previous)	NTP2

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
AP-27	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Gene and Pamela Williamson (previous)	NTP2
AP-32	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Saul Miguel and Victoria Villarreal (previous)	NTP2
AP-42	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Kenneth and Linda Mervin (previous)	NTP2
AP-46	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Germain Investment Company (previous)	NTP2
AP-50	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Victor Gutierrez (previous)	NTP2
AP-55	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Jacinto and Ivan Luiz Acevedo (previous)	NTP2
AP-60	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Traci J O'Brien (previous)	NTP2
AP-63	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Denver Public Schools (Swansea School)	NTP2
AP-66	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	JJH Inc. (Colonial Manor Motel)	12/31/17
AP-66A & AP-66B	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	JJH Inc. (Vacant Lots @ Colonial Motel)	12/31/17
AP-86 & AP-86A	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Pilot Travel Centers LLC	12/31/17
AP-86B	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Blue Beacon U.S.A., L.P.II, a Colo. LLC	12/31/17
AP-91	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Miles Lane Ltd. (previous)	12/31/16
AP-93	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Stanley J. Anderson Trust	12/31/17
AP-93A	Brighton Boulevard to Colorado Blvd.	DEPT – ACQ DEV – PM	Stanley J. Anderson Trust	12/31/17
AP-94	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Sno-White Linen & Uniform Rental, Inc.	6/30/17
AP-96	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Penske Truck Leasing Co., L.P.	6/30/17
AP-101	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Robert Macias (La Mex Bar and Grill) (previous)	6/30/17
AP-180 & AP-180A	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Harold Deter	12/31/17
AP-9	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Adamsclock LLC	6/30/17
AP-15	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Flamingo Vista LLC	6/30/17
AP-21	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Dadourian West LLC	6/30/17

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
AP-29	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ & PM	Eric Ely	6/30/17
AP-43	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Bruce and Wayne Medina	9/30/17
AP-44	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	John Slavinski	9/30/17
AP-45	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Michael Fritts	9/30/17
AP-47	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Richard Kevin Schneider Trust	9/30/17
AP-48	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Michael Fritts	9/30/17
AP-52	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Alternative Auto Solutions, LLC	9/30/17
AP-67	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Justin McLead	9/30/17
AP-28	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ; DEV – PM	Estolfo Rodelas and Octavio Rodelas-Medina	9/30/17
AP-72	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ; DEV – PM	Aurelio Ruiz	9/30/17
AP-102	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ; DEV – PM	Big B LLC	9/30/17
AP-169	Brighton Boulevard To Colorado Boulevard	DEPT – ACQ; DEV – PM	N.K. Sharma	9/30/17
AP-184	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ; DEV – PM	Anthony Sanchez	9/30/17
AP-185	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Albert and Agnes Garcia	9/30/17
AP-109	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ; DEV – PM	First Union Group	9/30/17
AP-122	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ; DEV – PM	5601, LLC	9/30/17
AP-26 (PE Only)	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	UPRR	6/30/17
TE-26	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	UPRR	6/30/17
AP-26I (PE Only)	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	UPRR	6/30/17
AP-26J (PE Only)	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	UPRR	6/30/17
RW-90	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	BNSF	12/31/17
TE-90	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	BNSF	12/31/17
RW-90A	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	BNSF	12/31/17

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
TE-90A	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	BNSF	12/31/17
RW-136	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	DRIR	6/30/17
RW-136A	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	DRIR	6/30/17
RW-136B	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	DRIR	6/30/17
RW-136C	Brighton Boulevard to Colorado Boulevard (Onsite Outfall)	DEPT – ACQ DEV – PM	DRIR	Absent Condemnation, 18 Months after Developer Notice to Dept. to Acquire
AP-139	Colorado Boulevard to Quebec Street	DEPT – ACQ DEV – PM	Colorado Eastern Railroad	6/30/17
PE-35	Brighton Boulevard to Colorado Boulevard (Onsite Outfall)	DEPT – ACQ DEV – PM	E&S Real Estate LLC	Absent Condemnation, 18 Months after Developer Notice to Dept. to Acquire
PE-36	Brighton Boulevard to Colorado Boulevard (Onsite Outfall)	DEPT – ACQ DEV – PM	Burlington Northern RR CO	Absent Condemnation, 18 Months after Developer Notice to Dept. to Acquire
PE-37	Brighton Boulevard to Colorado Boulevard (Onsite Outfall)	DEPT – ACQ DEV – PM	G&K Services Inc., owner	Absent Condemnation, 18 Months after Developer Notice to Dept. to Acquire
RW-38	Brighton Boulevard to Colorado Boulevard (Onsite Outfall)	DEPT – ACQ DEV – PM	Versacold USA, Inc.	Absent Condemnation, 18 Months after Developer Notice to Dept. to Acquire
PE-39	Brighton Boulevard to Colorado Boulevard (Onsite Outfall)	DEPT – ACQ DEV – PM	Middleton Properties LLC	Absent Condemenation, 18 Months after Developer Notice to Dept. to Acquire

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
PE-40	Brighton Boulevard to Colorado Boulevard (Onsite Outfall)	DEPT – ACQ DEV – PM	Rockyn Lazy L Land LLC	Absent Condemnation, 18 Months after Developer Notice to Dept. to Acquire
PE-197	Brighton Boulevard to Colorado Blvd. (Onsite Outfall)	DEPT – ACQ DEV – PM	KAI IWI Investments, LLC	Absent Condemnation, 18 Months after Developer Notice to Dept. Acquire
PE-200	Brighton Boulevard to Colorado Blvd. (Onsite Outfall)	DEPT – ACQ DEV – PM	BH Partnership B LP	Absent Condemnation, 18 Months after Developer Notice to Dept. Acquire
AP-182	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	The Western Stock Show Association	12/31/17
AP-182A	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	The Western Stock Show Association	12/31/17
RW-8	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Jack E. Ruddy	12/31/17
RW-14	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Marie Refugia Garcia	12/31/17
RW-33	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Cameron Gray	12/31/17
RW-34	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Anthony Toth	12/31/17
RW-49	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Vincent and Judy Sanchez	12/31/17
RW-49A	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Vincent and Judy Sanchez	12/31/17
RW-53	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Jeff Portales	12/31/17
RW-68	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Irene Luchetta and Dorothy Ann Magana	12/31/17
RW-69	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Charles Dady, Jr.	12/31/17
RW-70	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Oscar Ortiz and Leonila Rivera Carrera	12/31/17
RW-73	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Esiquia Rochas Casillas	12/31/17
RW-74	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Mauro Ramirez	12/31/17
RW-75	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Martinez Real Estate Trust	12/31/17
RW-77	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Lavonne Emiko Griffie	12/31/17

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
RW-78	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Diane Fleck	12/31/17
RW-79	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	46 Fillmore LLC	12/31/17
RW-80	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Mary Fletcher	12/31/17
RW-81	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Mary Santa Cruz Trust	12/31/17
RW-83	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Mayra Manuela and Juan Carlos Lodoza	12/31/17
RW-2	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Alberto Rocha	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
PE-25	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Nestle Purina Petcare Company	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-82	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Randall T. Lopez	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-84	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Carmelo Rivera Jr. and Orlinda Rivera	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-85	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	4500 Steele Street LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-87	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Perschbacher Investments LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
RW-89	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Manna Pro West, LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
TE-89	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Manna Pro West, LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
TE-191	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Farmers Marketing Association, a Disssolved Colo. Corp.	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
TE-192	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	Weakland Investments LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-92	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	BCP-45th Ave. I, LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-103	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	4600 Stapleton Drive Co., LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-104	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Wright & McGill CO.	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-105	Colorado Boulevard to Quebec St. (Partial Acquisition)	DEPT – ACQ DEV – PM	Safeway Stores 47, Inc.	Absent Condemnation, 12 months after Dept. Accepts Developer's Design

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
RW-106	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	McMillan Sales Corp.	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-111	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	I-70 Glencoe Forest RLLP, a Colo. LLP	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-112	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Glencoe LLC, a Colo. LLP	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-114	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Armas Properties, LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-115	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	SIST LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-116	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Sara S. Scott Trust	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-117	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Speidell Real Estate Group, LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-118	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Diner Group, LLP	Absent Condemnation, 12 months after Dept. Accepts Developer's Design

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
RW-119	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	John Priola Jr. Warehouse LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-121	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Van Waters & Rogers Inc.	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-123	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	University Park Real Estate LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-124	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Groll-Whisler Investments LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-125	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	4355 Kearney Street. LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-127	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	John Deere Plow Company	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-130 & RW-130A	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	462 Thomas Family Properties LP	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-132	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	4940 Jackson, LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
RW-134	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Micheal & Dianna Keffer	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-135	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Allen & Mary Ann Chappell	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-137	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Chimill Corp.	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-138	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	Upland Industries Corporation	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-170	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Paul and Maria Cristina Arrieta	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
AP-181	Brighton Boulevard to Colorado Boulevard (Partial Acquisition)	DEPT – ACQ DEV – PM	Forney Museum	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
AP-183	Brighton Boulevard to Colorado Boulevard	DEPT – ACQ DEV – PM	The Western Stock Show Association	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-196	Colorado Boulevard to Quebec Street (Partial Acquisition)	DEPT – ACQ DEV – PM	A&R Investment, LLC	Absent Condemnation, 12 months after Dept. Accepts Developer's Design

Parcel #	Design Section	DEPT = Department DEV = Developer ACQ = Acquisition PM = Property Mgmt.	Owner	Date first Available for Possession
RW-198	Colorado Boulevard to Quebec St. (Partial Acquisition)	DEPT- ACQ DEV – PM	St. Paul Properties, Inc.	Absent Condemnation, 12 months after Dept. Accepts Developer's Design
RW-199	Colorado Boulevard to Quebec St. (Partial Acquisition)	DEPT – ACQ DEV – PM	Upland Industries	Absent Condemnation, 12 months after Dept. Accepts Developer's Design

Appendix B
Steps to be followed by Developer in the Acquisition Process for Additional Right-of-Way

Note that all time frames in this table are approximations and not binding obligations upon, or assurances from, the Department.

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Acceptance or Approval of ROW Task	Approximate Time Frame for Acceptance or Approval of ROW Task	Comments
Survey	Developer	Variable depending on scope, 2-4 weeks for smaller surveys, 2-4 months for larger surveys	Department's Survey Unit	2-3 weeks from submission	This is only survey of property boundary and topography needed for development of Right of Way Plans.
Delivery of engineering design of improvements requiring ROW completed to a sufficient level to ensure that location, size and shape of ROW parcels will not change as design is advanced	Developer	Variable depending on scope of improvements to be designed	Developer's design review team and Department's ROW Manager	Variable depending on scope of improvements designed	Completion of sufficient design to this level is a common cause of delay in the Right of Way Plans development process
Appraisal and Appraisal review	Appraisal: Developer Appraisal review: Department	6-12 weeks per appraisal per landowner 2-4 weeks to review an appraisal	Department	2-4 weeks to review an appraisal	If the estimated value of the acquisition is $10,000 or less, a value finding can be prepared by a real estate specialist and an appraisal review of the value estimate is not needed. All requests for valuation by a value finding vs. an appraisal must be Approved by Department.

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Acceptance or Approval of ROW Task	Approximate Time Frame for Acceptance or Approval of ROW Task	Comments
Acquisition negotiation	Developer	4-6 weeks for the initial negotiation. 2 weeks for a final offer letter. 2 weeks for a last and final offer letter, if given. At least 4 months from submission of request for condemnation to completing immediate possession hearing.	Department must review and Approve certain administrative settlements. Developer shall be delegated the same administrative settlement authority as the "Region" as set out in Section 10.2.1 of CDOT Right of Way Manual. Department's Region 1 shall be delegated the same administrative settlement authority as "Central Office" as set out in Section 10.2.1 of the CDOT Right of Way Manual.	2-4 Calendar Days to review and Approve backup documentation of completed acquisition negotiations	Developer cannot use duress or coercion in acquisition negotiations
Condemnation	Colorado Attorney General's Office	At least four months to file a condemnation petition, serve it on the parties, set and hold an immediate possession hearing. Valuation trials can take a year or more from the date of filing the condemnation petition.			All offers to purchase must be made in the Department's name, so the Attorney General's Office is properly authorized to represent the Department as the condemning authority in the condemnation proceeding.

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Acceptance or Approval of ROW Task	Approximate Time Frame for Acceptance or Approval of ROW Task	Comments
Certification that acquisition was completed in compliance with state and federal requirements	Developer		Department's ROW Manager		

Appendix C
Steps to be followed by Developer in the Relocation Process.

Note that all time frames in this table are approximations and not binding obligations upon, or assurances from, the Department.

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Acceptance or Approval of ROW Task	Approximate Time Frame for Completion of Acceptance or Approval of ROW Task	Comments
Relocation Planning Studies Required by 49 CFR §24.205	Developer	Variable depending on scope; 1-2 weeks for smaller studies; 60-90 Calendar Days for larger studies	Department's Headquarter ROW Unit	1-3 weeks from submission, depending on size of the study	
Relocation Advisory Services Required by 49 CFR §24.205	Developer	Variable. Typically continuous throughout relocation process.	Department's Acquisition / Relocation Supervisor. Note: Approval of a specific Deliverable is not required. Rather this is general oversight by the Department.	Generally continuous throughout relocation process.	Department's Acquisition / Relocation personnel can assist with advisory services, as needed.

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Acceptance or Approval of ROW Task	Approximate Time Frame for Completion of Acceptance or Approval of ROW Task	Comments
Provide displaced occupants with notice that they have 90 Calendar Days to vacate the premises and, additionally, later notice that they have 30 Calendar Days to vacate the premises 49 CFR §24.203	Developer	The 90 Day notice is provided at the time the written offer to purchase the property is provided to the landowner	Department's Acquisition / Relocation Supervisor. Note: Approval of a specific Deliverable is not required. Rather this is general oversight by the Department.		90 Calendar Days for a displaced occupant to find a replacement property and move into it is the minimum required by law. As a practical matter, that is too short, especially for displaced businesses. It is desirable to lengthen this minimum time frame as much as possible. At least 6 months is a better expectation. The 30 Calendar Day notice cannot be provided until possession of the underlying property is obtained.

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Acceptance or Approval of ROW Task	Approximate Time Frame for Completion of Acceptance or Approval of ROW Task	Comments
Business Relocation Prepare and submit requests for reimbursement of all available business relocation monetary benefits, including expenses incurred searching for a replacement property, 49 CFR §24.301, moving expenses, 49 CFR §24.301, reestablishment 49 CFR §24.304, or single "in lieu" payment, 49 CFR §24.305	Developer	Variable	Department's Headquarter ROW Unit	2-5 Calendar Days per submittal	Since these are reimbursable expenses, the displaced occupant must actually incur the expenses before a request for reimbursement can be prepared.
Residential Relocation Prepare and submit requests for reimbursement of all available residential relocation monetary benefits, including replacement housing payment, 49 CFR §24.401 and moving expenses, 49 CFR §24.301	Developer	Variable	Department's Headquarter ROW Unit	5-10 Calendar Days per submittal	Since these are reimbursable expenses, the displaced occupant must actually incur the expenses before a request for reimbursement can be prepared.

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Acceptance or Approval of ROW Task	Approximate Time Frame for Completion of Acceptance or Approval of ROW Task	Comments
Certification that acquisition was completed in compliance with State and Federal requirements	Developer		Department's ROW Manager		

Schedule 19
Forms of Direct Agreements

[*To be provided in a subsequent Addendum*]

Schedule 20
Forms of Contractor Bonds

[*To be provided in a subsequent Addendum*]

Schedule 21
Forms of Supervening Event Submissions

[*To be provided in a subsequent Addendum*]

Schedule 22
Forms of Legal Opinions

[*To be provided in a subsequent Addendum*]

Schedule 23
Form of Financial Model Escrow Agreement

[*To be provided in a subsequent Addendum*]

Schedule 24
Change Procedure

[*To be provided in a subsequent Addendum*]

Schedule 25
Dispute Resolution Procedures

[*To be provided in a subsequent Addendum*]

Schedule 26
Base Case Model

[*To be inserted based on Preferred Proposer's Proposal*]

Schedule 27
Key Personnel[1]

Project Manager

Position Description:	Responsible for overall execution and administration of Developer's responsibilities for the Project, with authority to bind Developer on all matters delegatable pursuant to Law and Developer's governing documents affecting Project execution and administration, including (i) with respect to design, construction, commissioning, operations, and maintenance; and (ii) authority to suspend Work.
Qualifications:	The Project Manager shall have demonstrated experience and expertise on a similar role in the delivery of projects similar in scope, value, nature, and complexity to the Project.
Minimum Period of Availability:	From Agreement Date to the end of the Term.
To be seconded to/employed by:	Developer
Name:	[*To fill in prior to execution of this Agreement.*]

Construction Manager

Position Description:	Responsible for ensuring that the Project is constructed in accordance with all requirements of this Agreement. Responsible for managing Construction Contractor's construction personnel, scheduling of the construction quality assurance personnel, and administering compliance with all Technical Requirements applicable to the Construction Work. The Construction Manager shall have the authority to suspend Construction Work.
Qualifications:	The Construction Manager shall have a minimum of 15 years' experience in construction and management of construction on highway projects similar in scope, value, nature, and complexity to the Project, with an emphasis on design-build experience and experience with interstate highways and interstate bridges.
Minimum Period of Availability:	From Agreement Date to Final Acceptance.
To be seconded to/employed by:	Construction Contractor
Name:	[*To fill in prior to execution of this Agreement.*]

[1] Note to Proposers: Schedule to be completed prior to execution with the identities of the approved Key Personnel as described in the ITP.

Design-Build Manager

Position Description:	Responsible for the overall design and construction of the Project and for managing Developer's design-build team. The Design-Build Manager shall (i) ensure that the Project is designed and constructed in accordance with the Technical Requirements; and (ii) have authority to suspend Work.
Qualifications:	The Design-Build Manager shall have a minimum of 20 years' experience, including a minimum of 15 years' design-build experience, in construction and management of design and construction on highway projects that included work of a similar scope, value, nature, and complexity as included in the Project.
Minimum Period of Availability:	From Agreement Date to Final Acceptance.
To be seconded to/employed by:	Construction Contractor
Name:	[*To fill in prior to execution of this Agreement.*]

Design Manager

Position Description:	Responsible for (i) ensuring that the overall Project design is completed and design criteria requirements are met; (ii) managing the design team's personnel; and (iii) administering all design requirements in this Agreement. The Design Manager shall have authority to suspend design Work and shall provide monthly certification that the Construction Work is being performed in compliance with the Project design.
Qualifications:	The Design Manager shall be a professional engineer licensed in the State no later than the date of issuance of NTP1. The Design Manager shall have a minimum of 15 years' experience in managing design for multidisciplinary highway projects with similar scope, value, nature, and complexity to the Project, with emphasis on design-build experience and experience with interstate highway, interstate bridges, and projects of similar scope, value, nature, and complexity to the Project.
Minimum Period of Availability:	From Agreement Date to Final Acceptance.
To be seconded to/employed by:	Principal Design Work Subcontractor to the Construction Contractor
Name:	[*To fill in prior to execution of this Agreement.*]

O&M Manager

Position Description: Responsible for ensuring that all O&M Work and (at Developer's election) Renewal Work requirements of this Agreement are met.

Qualifications: The O&M Manager shall have demonstrated experience and expertise in a similar role on managing the operations, maintenance and (at Developer's election) rehabilitation work on highway projects of similar scope, value, nature, and complexity to the Project.

Minimum Period of Availability: From Agreement Date to the end of the Term.

To be seconded to/employed by: O&M Contractor

Name: [*To fill in prior to execution of this Agreement.*]

Project Quality Manager

Position Description: Responsible for overall quality management of the Project. The Project Quality Manager shall have the authority to suspend Work and shall provide monthly certification that Work is being performed in compliance with Law.

Qualifications: The Project Quality Manager shall be a professional engineer licensed in the State no later than the date of issuance of NTP1, and shall have a minimum of eight years' experience in infrastructure transportation project design and construction, including at least five years' experience in quality assurance activities, including the preparation and implementation of quality plans and procedures for design, construction, and operations on transportation projects that included work of a similar scope, value, nature, and complexity to the Project.

Minimum Period of Availability: From Agreement Date to the end of the Term.

To be seconded to/employed by: The Project Quality Manager shall be employed by the Independent Quality Control Firm. The Project Quality Manager can hold only this Key Personnel position.

Name: [*To fill in prior to execution of this Agreement.*]

Independent Design Quality Manager

Position Description: Responsible for ensuring quality management on all Design Work carried out on the Project, the Independent Design Quality Manager shall have the authority to suspend Work.

Qualifications: The Independent Design Quality Manager shall be a professional

engineer licensed in the State no later than the date of issuance of NTP1, and shall have a minimum of eight years' experience in highway design, including at least five years' experience in quality assurance activities, including the preparation and implementation of quality plans and procedures for design on highway projects that included work of a similar scope, value, nature, and complexity to the Project.

Minimum Period of Availability: From Agreement Date to Final Acceptance.

To be seconded to/employed by: The Independent Design Quality Manager shall be employed by the Independent Quality Control Firm.

Name: [*To fill in prior to execution of this Agreement.*]

Construction Process Control Manager

Position Description: Responsible for ensuring all methods and procedures contained in the approved Stage 2 QMP are carried out on the Project, the Construction Process Control Manager shall have authority to suspend Work.

Qualifications: The Construction Process Control Manager shall be a professional engineer licensed in the State or possess a National Institute for Certification of Engineering Technologies (NICET) Level III Certificate in Highway Materials or Construction Materials with the soil, concrete, and asphalt sub-fields, as well as have or obtain the American Society for Quality (ASQ) certification as a quality inspector, quality engineer, or manager of quality, in each case prior to the date of issuance of NTP2. The Construction Process Control Manager shall have a minimum of eight years' highway construction experience on projects that included work of a similar scope, value, nature, and complexity to the Project.

Minimum Period of Availability: From Agreement Date to the end of the Term.

To be seconded to/employed by: Construction Contractor

Name: [*To fill in prior to execution of this Agreement.*]

Independent Quality Control Manager

Position Description: Responsible for managing all independent Quality Control aspects contained in the approved Stage 2 QMP that are carried out on the Project, including having authority to suspend Work.

Qualifications: The Independent Quality Control Manager shall be a professional engineer licensed in the State no later than the date of issuance of NTP1, and shall have a minimum of eight years' experience in

transportation construction on projects that included work of a similar scope, value, nature, and complexity to the Project, five years of which shall be experience in developing and implementing similar quality control programs on transportation projects. The Independent Quality Control Manager shall have or obtain the American Society for Quality (ASQ) certification as a quality inspector, quality engineer, or manager of quality prior to the date of issuance of NTP2.

Minimum Period of Availability: From Agreement Date to the end of the Term.

To be seconded to/employed by: The Independent Quality Control Manager shall be employed by the Independent Quality Control Firm.

Name: [*To fill in prior to execution of this Agreement.*]

Environmental Manager

Position Description: The Environmental Manager is responsible for ensuring compliance with all Environmental Requirements and commitments. The Environmental Manager shall have authority to suspend Work.

Qualifications: The Environmental Manager shall possess seven years' progressive experience working on projects of similar scope, value, nature, and complexity to the Project. The Environmental Manager shall also demonstrate the ability to work effectively with both design and construction staff.

Minimum Period of Availability: From Agreement Date to the second anniversary of Final Acceptance.

To be seconded to/employed by: Developer

Name: [*To fill in prior to execution of this Agreement.*]

Utilities Manager

Position Description: Responsible for managing all required Utility Work and coordinating the same with Utility Owners.

Qualifications: The Utilities Manager is a management role with a minimum of five years' relevant experience on major infrastructure projects of similar scope, value, nature and complexity to the Project.

Minimum Period of Availability: From Agreement Date to Final Acceptance.

To be seconded to/employed by: Construction Contractor

Name: [*To fill in prior to execution of this Agreement.*]

Project Communications Manager

Position Description:	Responsible for overseeing all Developer communications efforts during construction, operations, and maintenance.
Qualifications:	The Project Communications Manager shall have (i) seven years' professional experience working on design-build construction projects and a practical understanding of construction schedules, MOT plans, and work performance processes; (ii) experience with, and understanding of, complexities and importance of maintaining good relationships between the Project and government, businesses, residents, the general public, and other stakeholders; and (iii) experience with implementing communication and public involvement plans on projects of similar scope, value, nature, and complexity to the Project.
Minimum Period of Availability:	From Agreement Date to the end of the Term.
To be seconded to/employed by:	Developer
Name:	[*To fill in prior to execution of this Agreement.*]

Schedule 28
Proposal Extracts

[*To be inserted based on Preferred Proposer's Proposal*]

Schedule 29
Reference Documents

1. REFERENCE DOCUMENTS

Availability Legend

NS = Document not supplied with RFP

S = Document supplied with RFP

Date Issued: Date the document was listed or supplied with the RFP

Table 1 Reference Documents

Doc #	Document	Date Issued	Availability
10.2	**Maintenance of Traffic**		
29.10.2.01	2012, 2021, and 2035 Synchro, HCS, DynusT, and TDM Models		S
10.3	**ITS and Tolling Equipment**		
29.10.3.01	I-70 East Concept of Operations	9/29/2015	S
29.10.3.02	ITS Infrastructure Details	9/29/2015	S
10.4	**Utilities**		
29.10.4.01	Utility Owner Contact List	9/29/2015	S
29.10.4.02	Utility Matrix	9/29/2015	S
29.10.4.03	Potholing Logs	9/29/2015	S
29.10.4.04	Preliminary Utility Plans	9/29/2015	S
29.10.4.05	Utility Owner Mapping Files	9/29/2015	S
29.10.4.06	Meeting Minutes	9/29/2015	S
29.10.4.07	Miscellaneous	9/29/2015	S
29.10.4.08	Utility Relocation Agreements		S
29.10.4.09	Existing Utility Model: I-25 to Tower Road	9/29/2015	S
29.10.4.10	Proposed Utility Model: I-25 to Tower Road	9/29/2015	S
10.5	**Survey**		
29.10.5.01	I-70 InRoads DTM: I-25 to Sand Creek	9/29/2015	S
29.10.5.02	I-70 InRoads DTM: Sand Creek to Airport Road	9/29/2015	S

Doc #	Document	Date Issued	Availability
29.10.5.03	Lidar Inroads DTM of UPRR Yard and 46th Ave: Brighton to Garfield St (under Viaduct)	9/29/2015	S
29.10.5.04	I-70 InRoads DTM (Onsite Outfall Area)	9/29/2015	S
29.10.5.05	Planimetrics Mapping: I-25 to Sand Creek and Storm Drain Outfalls	9/29/2015	S
29.10.5.06	Planimetrics Mapping and 3D Breaklines: Sand Creek to Airport Road	9/29/2015	S
29.10.5.07	Lidar Planimetrics Mapping of UPRR Yard and 46th Ave: Brighton to Garfield St (under viaduct)	9/29/2015	S
29.10.5.08	Planimetrics Mapping: OnSite Outfall Area (supplemental)	9/29/2015	S
29.10.5.09	3D Breaklines: I-25 to Sand Creek and Storm Drain Outfalls	9/29/2015	S
29.10.5.10	3D Breaklines: UPRR Yard and 46th Ave: Brighton to Garfield St (under Viaduct)	9/29/2015	S
29.10.5.11	Utility Locates Survey: Brighton to Sand Creek and Storm Drain Outfalls	9/29/2015	S
29.10.5.12	Storm and Sanitary Manhole Survey: Brighton to Sand Creek and Storm Outfalls	9/29/2015	S
29.10.5.13	Utility Locates Survey: Sand Creek to Airport Road	9/29/2015	S
29.10.5.14	Storm and Sanitary Manhole Survey: Sand Creek to Airport Road	9/29/2015	S
29.10.5.15	Existing Contours: I-25 to Sand Creek and Storm Drain Outfalls	9/29/2015	S
29.10.5.16	Existing Contours: Sand Creek to Airport Road	9/29/2015	S
29.10.5.17	Aerial Image: I-25 to I-270	9/29/2015	S
29.10.5.18	Aerial Image: I-270 to Tower Road	9/29/2015	S
29.10.5.19	CDOT Interstate 70 East Viaduct Horizontal and Vertical Control Survey Report for Aerial Mapping Volume 1	9/29/2015	S
29.10.5.20	CDOT Interstate 70 East Viaduct Horizontal and Vertical Control Survey Report for Aerial Mapping Volume 2	9/29/2015	S
10.6	**Roadway Pavements**		
29.10.6.01	Preliminary Subsurface Investigation Report Brighton Boulevard to Chambers Road	9/29/2015	S
29.10.6.02	Preliminary Subsurface Investigation Report for Partial Cover Lowered (PCL) Alternative	9/29/2015	S
29.10.6.03	Preliminary Subsurface Investigation Report for Partial Cover Lowered (PCL) Alternative Addendum	9/29/2015	S
10.7	**Earthwork**		
29.10.7.01	CDOT Online Transportation Information System (OTIS)	9/29/2015	NS
10.8	**Drainage**		

Doc #	Document	Date Issued	Availability
29.10.8.01	Multi Agency Technical Team (Matt) Memos	9/29/2015	S
29.10.8.02	High Street Outfall & 40th Ave System	9/29/2015	S
29.10.8.03	Final - Hydraulic Design Report for I-70 Over Sand Creek	9/29/2015	S
29.10.8.04	Final Drainage Study for Safeway Distribution Center's North Parking Area at I-70 and Dahlia Street	9/29/2015	S
29.10.8.05	Sand Creek FEMA Models	9/29/2015	S
29.10.8.06	Final Drainage Report for I-70 over Havana Street Design-Build	9/29/2015	S
29.10.8.07	Parkhill Storm PH IV-B Plans	9/29/2015	S
29.10.8.08	CE00024 Parkhill Storm Ph IV-51st-St Paul-Drainage Report	9/29/2015	S
29.10.8.09	Final Drainage Report Central Park Boulevard Interchange with I-70	9/29/2015	S
29.10.8.10	Preliminary Drainage Report Brighton Boulevard Preliminary Design 44th street to Race Court	9/29/2015	S
29.10.8.11	Baranmor Ditch OSP	9/29/2015	S
29.10.8.12	Draft Master Drainage Report	9/29/2015	S
29.10.8.13	Draft Master Water Quality Report	9/29/2015	S
29.10.8.14	Drainage Plans	9/29/2015	S
29.10.8.15	Drainage Calculations and Models	9/29/2015	S
29.10.8.16	Drainage Microstation Files	9/29/2015	S
10.9	**Roadway**		
29.10.9.01	Roadway Plans	9/29/2015	S
29.10.9.02	Pedestrian Bridge at 47th Avenue over UPRR Site Plan		S
29.10.9.03	Second Cover Feasibility Report		S
29.10.9.04	Havana Street Design Build Project RFC Plans	9/29/2015	S
29.10.9.05	As-Builts	9/29/2015	S
29.10.9.06	IGA – CDOT and City and County of Denver	9/29/2015	S
29.10.9.07	Roadway Microstation Files	9/29/2015	S
29.10.9.08	Roadway InRoads Geometry Files	9/29/2015	S
10.10	**Railroads**		

Doc #	Document	Date Issued	Availability
29.10.10.01	UPRR 30% Package: Interstate 70 Under UPRR Bridge (36th Yard): Track Relocation Plans		S
29.10.10.02	BNSF 30% Package: Interstate 70 Under BNSF Market Lead: Track Relocation Plans		S
29.10.10.03	Railroad Agreements		S
29.10.10.04	Railroad Microstation Files	9/29/2015	S
29.10.10.05	Railroad InRoads Geometry Files		S
10.11	**Signing, Pavement Markings, Signalization, and Lighting**		
29.10.11.01	Interstate Access Request		S
29.10.11.02	CCD Fiber Signal Interconnect Map	9/29/2015	S
10.12	**Cover MEP System**		
29.10.12.01	Design Fire Size	9/29/2015	S
29.10.12.02	Ventilation and Fire Life Safety Report	9/29/2015	S
29.10.12.03	CFD Modeling Study of Emergency Ventilation	9/29/2015	S
10.13	**Structures**		
29.10.13.01	Structure Plans	9/29/2015	S
29.10.13.02	Bridge Inspection Reports	9/29/2015	S
29.10.13.03	Structure Microstation Files	9/29/2015	S
10.14	**Landscaping and Aesthetics**		
29.10.14.01	Draft I-70 East Preferred Alternative Aesthetic and Design Guidelines	9/29/2015	S
29.10.14.02	I-70 East Cover and Swansea Elementary School Master Plan	9/29/2015	S
11	**Operations and Maintenance**		
29.11.01	Operations and Maintenance Plans	9/29/2015	S
17	**Environmental Requirements**		
29.17.01	I-70 East Supplemental Draft Environmental Impact Statement	9/29/2015	NS
29.17.02	I-70 East Final Environmental Impact Statement		NS
29.17.03	I-70 East Record of Decision		NS
29.17.04	I-70 East Mitigation Measures Status		S
29.17.05	Limited Subsurface Investigation Report	9/29/2015	S

Doc #	Document	Date Issued	Availability
29.17.06	Environmental Site Assessments	9/29/2015	S
29.17.07	Existing Wetland Delineation	9/29/2015	S
29.17.08	GeoData Base Environmental Map (combined findings of Phase I Residential Investigations Only)		S
29.17.09	Elyria and Swansea Neighborhood Plan	9/29/2015	NS
29.17.10	Noise Models		S
18	**Right-of-Way**		
29.18.01	Final Site Improvement Plans for Safeway Distribution Center North Employee & Visitor Parking Area	9/29/2015	S
29.18.02	Purina Structure As-Built Plans	9/29/2015	S
29.18.03	Purina Utility Plans	9/29/2015	S
29.18.04	Right-of-Way Microstation Files	9/29/2015	S
29.18.05	Title Commitments	9/29/2015	S