

12.0 Drainage

12.1 General

The Project shall include all Work for the modification of existing drainage facilities, construction of new drainage facilities and construction of permanent Best Management Practices (BMPs) required to convey and contain or treat design flows for the Project. The Project shall also meet Project design criteria, and comply with the terms and conditions of the CDOT Municipal Separate Storm Sewer System (MS4) Permit and all other water quality laws and regulations. Both permanent water quality and construction stormwater quality are controlled by this permit and these laws and regulations.

The Contractor shall design and construct a complete system to contain or treat runoff resulting from activation of the Fixed Fire Suppression System, while minimizing flood damages, water quality impacts, and future operation and maintenance costs.

The EJMT drains from west to east. The current drainage system within the tunnel has adequate capacity to handle the existing roadway drainage. Fire Suppression System flows that surcharge the existing roadway drainage system are allowed to flow in the tunnel roadway to a point of capture at the east portal.

All existing cross drains, storm drains, and drainage appurtenances to be abandoned shall be removed or plugged and filled with flow-fill in accordance with the Standard Specifications, Section 202.

All new drainage facilities for the Project shall be constructed to meet Project design criteria. The Contractor shall obtain approval from affected agencies for any proposed on-Site drainage improvements that are connected to existing storm drains, upstream or downstream of the Project.

If the Contractor proposes that existing drainage patterns must be changed, the Contractor shall design a solution that does not adversely impact property owners outside the ROW, shall obtain Approval from CDOT prior to construction, and shall secure all other necessary approvals, permits, and easements.

12.1.1 Standards

The Contractor shall design and construct the drainage system in accordance with the requirements of the standards listed in Table 12-1. Where standards conflict, the more stringent shall apply.

Table 12-1: Standards for Drainage

Author or Agency	Title
CDOT	<i>Standard Specifications for Road and Bridge Construction</i>
CDOT	<i>Standard Plans, M & S Standards</i>
CDOT	<i>Drainage Design Manual</i>

12.1.2 Design Guidelines

The Contractor shall design and construct the drainage system in accordance with the requirements of the guidelines listed in Table 12-2.

Table 12-2: Design Guidelines for Drainage

Author or Agency	Title
AASHTO	<i>A Policy on Geometric Design of Highways and Streets</i>
FHWA	<i>Drainage of Highway Pavements, HEC-12</i>
FHWA	<i>Design of Roadside Channels with Flexible Linings, HEC-15</i>
FHWA	<i>Hydraulic Design of Improved Inlets for Culverts, HEC-13</i>
FHWA	<i>Hydraulic Design of Highway Culverts, HDS-5</i>
CDOT	<i>Erosion Control and Stormwater Quality Guide</i>
CDOT	<i>Water Quality Guidance for Consultants</i>

12.2 Administrative Requirements

12.2.1 Coordination with Other Agencies and Disciplines

The Contractor shall coordinate all drainage-related issues with affected regulatory agencies where appropriate. The Contractor shall include CDOT in all contacts with appropriate regulatory agencies.

12.3 Design Requirements

12.3.1 Drainage Design Software

All drainage and runoff design shall be performed by a Colorado Licensed Professional Engineer. All software utilized for the design shall be referenced in the drainage report, and data files shall be provided as an appendix in the drainage report.

12.3.2 Data Collection

The Contractor shall identify all drainage related issues utilizing available data, including but not limited to, requirements imposed by local, state, and federal government regulations, and official documents concerning the Project. 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.

The Contractor shall perform detailed mapping and surveys as required to verify locations of existing drainage features necessary for the proposed drainage design.

The Contractor shall resolve all conflicts between Utilities and proposed drainage improvements in accordance with Book 2, Section 7.

12.3.3 Hydraulic Structures

12.3.3.1 Storm Drain Alignment, Profile, and Size

Storm drain alignments shall be straight between structures.

Profiles of all storm drains shall be straight grades between structures.

12.3.3.2 Inlets

Inlets are required at locations needed 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 should be marked on the plans prior to any computations regarding discharge, water spread, inlet capacity, or bypass.

Inlets shall not be located in a path where pedestrians are likely to walk.

M&S Standard Plans inlets shall be used within CDOT ROW. Type C and Type D inlets shall not be allowed within the roadway pavement limits unless used in conjunction with embankment protectors. Inlets shall be designed for HS-20 or interstate alternate live loading.

Concrete aprons shall be installed on all area inlets per the M&S Standard Plans.

Access holes such as inlets, catch basins, and manholes shall not be located in the travel lanes of I-70.

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.

12.3.3.3 Manholes and Junction Structures

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.

A lateral that is less than half the size (inside diameter) of the trunk line and no more than 75 feet long may be connected to the trunk line with a prefabricated pipe wye or tee connection. Larger laterals shall be connected to the trunk line with a manhole.

The spacing of manholes shall be in accordance with the criteria identified in the CDOT Drainage Design Manual.

Manhole and junction structure floors shall be shaped to fit the pipe inverts.

12.3.3.4 Permanent Best Management Practices

No permanent Water Quality BMPs are required for stormwater runoff with this project. The fire system runoff shall be contained for haulage and treatment off-Site unless the Contractor can demonstrate adequate treatment of such flows on-Site.

12.4 Construction Requirements

Drainage facilities shall be constructed in accordance with the Standard Specifications and M&S Standard Plans.

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12.4.1 Pipe Material Selection Policy

The Contractor shall comply with the CDOT Design Bulletin Pipe Material Selection Policy which is included in Book 3. The most current version as signed by the CDOT Chief Engineer at the time of the Request for Proposals (RFP) shall be utilized.

Clarifications of the CDOT Design Bulletin Pipe Material Selection Policy are as follows:

1. Trial installations are not allowed on this Project.
2. The Contractor shall be required to sample soil and water.
3. "Project Manager" implies "Contractor."
4. The Contractor shall provide a Sampling Schedule for Pipe Selection for CDOT Review prior to NTP2.
5. Pipe material selection shall be submitted to CDOT for Acceptance as part of the Drainage Reports.
6. Aluminum alloy pipe shall not be used.

12.5 Reports

12.5.1 Drainage Reports

Interim Drainage Reports shall be prepared by the Contractor and submitted for Review prior to issuance of Released for Construction documents that include the subject drainage facilities.

A Final Drainage Report, incorporating addenda to previously submitted Interim Drainage Reports, shall be prepared by the Contractor and submitted for Acceptance prior to the issuance of Released for Construction documents that include the subject drainage facilities.

The interim and final drainage reports shall follow the documentation procedure in Chapter 4 of the CDOT Drainage Design Manual.

The drainage reports shall include the following:

1. A discussion of the runoff rates and durations expected from the activation of the Fixed Fire Suppression System, as well as a discussion of the possible contaminants present in the runoff from the Fixed Fire Suppression System. 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.
2. Rationale for sizing and selection of all drainage elements, including catch basins, storm drain systems, cross drains, ditches, swales, BMPs, extended detention facilities, and pipe materials selection.
3. Hydraulic data sheets with a summary of hydraulic design information for each storm drain.
4. Existing drainage patterns for both highway and cross-drainage flows, drainage parameters, discharge characteristics, and other information necessary for the design of the drainage system. All drainage reports shall include documentation of any tributary flows from areas outside of each construction segment as defined by the Contractor.
5. Documentation that the proposed runoff will be controlled and treated in accordance with this Section and all drainage and water quality permits.
6. Documentation of existing drainage discharge rates and outfall locations.
7. Documentation of the impact of proposed drainage designs on existing drainage facilities.

In addition to the documentation procedure in Chapter 4 of the CDOT Drainage Design Manual, the Contractor shall closely follow the report outline below. The section and subsection headings shall be maintained at a

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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.

Drainage Report Outline

1. Introduction
 - 1.1. Location of Improvements
 - 1.2. Description of Improvements
 - 1.3. Discussion of Drainage Investigation
2. Roadway Drainage Systems
 - 2.1. General Discussion
 - 2.2. Design Coordination
 - 2.2.1. Agency Coordination
 - 2.3. Hydrology and Design Flow Development
 - 2.4. Pavement, Median, and Roadside Drainage
 - 2.4.1. Inlet/Catch Basin Spacing Design
 - 2.4.2. Storm Drain Design
 - 2.4.3. Erosion Control Design
3. Permanent Best Management Practices
 - 3.1. Assumptions and Methodologies
 - 3.1.1. Allowable Release Rate Discussion
 - 3.2. Hydrology and Hydraulics
 - 3.3. Storage and Outlet Design Determination
 - 3.4. Adherence to the CDOT MS4 Permit and NDRD Requirements
4. Appendices
 - 4.1. Hydrologic Analysis
 - 4.1.1. On-Site Hydrology
 - 4.1.2. Off-Site Hydrology
 - 4.1.3. Precipitation Data
 - 4.1.4. Soil Survey
 - 4.2. Hydraulic Analysis
 - 4.2.1. Spread Width, Inlet and Storm Drain Calculations
 - 4.2.2. Hydraulic Grade Line Calculations
 - 4.2.3. Erosion Control Calculations
 - 4.3. Permanent Best Management Practices
 - 4.3.1. Storage Calculations
 - 4.3.2. Water Quality Structure Calculations
 - 4.4. Maintenance Exhibit

The Contractor shall submit three hard copies of all Interim Drainage Reports and three hard copies of the Final Drainage Report. All drainage reports shall be signed and sealed by a Colorado Licensed Professional Engineer. The Contractor shall submit one electronic copy of all signed and sealed drainage reports in PDF format. All drainage reports shall include electronic copies of all computer analysis input and output files in the native file format.

12.6 Drainage Design Deliverables

The Contractor shall prepare plans for all drainage related facilities for the Project in a format that follows the documentation procedure in Chapter 4 of the CDOT Drainage Design Manual, CDOT CADD Manual, and CDOT Drafting Manual.

The Contractor shall submit all applicable plans with each Drainage Report.

All deliverables shall follow the Quality Management Plan for the Project as described in Book 2, Section 3.

The Contractor shall include the following for all drainage plan deliverables:

1. Plan View
 - 1.1. Provide the location of all existing and proposed storm drains. Provide a label for each proposed storm drain location. The Contractor 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 at a minimum the Drain Line and Sheet Number where the profile can be found.
 - 1.2. 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, outlet structure, and outlet protection. Include a table that summarizes all pertinent information. The table shall include, at a minimum, the Label ID, Station & Offset, Item, Length, Pay Depth, and Notes.
 - 1.3. Provide all existing and proposed grading.
 - 1.4. Provide all Utility locations.
 - 1.5. Provide location of ROW lines.
2. Profiles
 - 2.1. 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, utility crossings, 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.
3. Drainage Details
 - 3.1. Include details for all non-standard CDOT items.

12.6.1 As-Built Documents

Clearly label and locate all items of Work with station, offset, and elevation information based on surveys of what was actually built in the field. Provide summaries of all As-Built drains with the following hydraulic information, at a minimum: pipe/culvert size, invert elevations, slope, Fire Suppression activation design flow, and HGL.

12.7 Deliverables

At a minimum, the Contractor shall submit the following to CDOT and all applicable review agencies for Review, Approval, and/or Acceptance. The Contractor shall identify and coordinate all required approvals by CDOT and outside agencies.

Table 12-3: Deliverables by the Contractor

Deliverable	Review, Acceptance, or Approval	Schedule
Sampling Schedule for Pipe Selection	Review	Prior to NTP2
Drainage Plans, Profiles, and Details	Acceptance	Prior to issuance of Released for Construction Documents
Interim Drainage Reports	Review	Prior to issuance of Released for Construction Documents
Final Drainage Report	Acceptance	Prior to issuance of Released for Construction Documents

12.8 Project Special Provisions

Subsection 603.07(a) shall include the following:

Joints for all circular 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 624.03 shall include the following:

Joint systems, irrigation systems, cross drains, and storm drains shall be watertight. Testing of joints shall be performed by the Contractor in accordance with approved methods. Should any section of irrigation system, cross drains, and/or storm drains fail to meet the test requirements, it shall be corrected at the Contractor's expense.