Boulder County

Transportation Department

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Memorandum

To: All Engineering Consultants and Interested Parties

From: Mike Thomas, County Engineer

Subject: Road Overtopping and the Boulder County Storm Drainage Criteria Manual

As engineering designs of county roads in the mountains have begun, with the objective of reconstructing the roads from their post-flood winter conditions to permanent conditions, many questions have surfaced concerning how to design the roads for resiliency and in accordance with county standards. The most common question for engineering staff and design consultants is what the Boulder County Storm Drainage Criteria Manual (SDCM) requires for overtopping maximums on rebuilt roadways. Boulder County's current SDCM was written by WRC Engineering, Inc., and completed in 1984. Except for a November 2014 update to Section 1000, regarding standards for private crossings of waterways, no other revisions or updates have been made to the SDCM since its original adoption.

The intent of this memo is to clarify the standards and requirements set forth in the SDCM and to interpret when and where overtopping maximums on roadways are applied. Although streets and roadways are an integral part of any local drainage system, they are typically utilized as an already existing feature within a drainage basin, which may or may not be subject to modification. Design of new and reconstructed roadways does not appear to be expressly addressed in the SDCM, except at bridge and culvert crossings. As a result, it is best for new and reconstructed streets and roadways to be included in a master planning process that addresses public safety, emergency access and maximum overtopping limits along the entire roadway corridor.

Overtopping Maximums Addressed in the Current SDCM

The SDCM includes requirements for maximum overtopping (allowable depths) at roadways in the following two scenarios:

1. Street (or Roadway) Capacity – SDCM Section 304.5 (Streets) states Boulder County's policy allows the use of streets for drainage to manage the minor (5-year) and major (100-year) drainage systems. In its traditional application, streets are part of an urban or suburban system that includes storm drainage using curb and gutter, inlets, drains and underground storm sewers. As a result, there are varying depths and limits of encroachment allowed based on road classification.

Utilizing roadway capacity for drainage conveyance in the mountains is not possible in most cases due to geologic conditions, limited right-of-way and steep grades. The ideal way to handle runoff on mountain roads is to keep it off the roadway. This is accomplished best with frequent cross culverts that drain to natural water features such as creeks or streams.

2. Culvert and Bridge Crossings – SDCM Section 1000 (Culverts and Bridges) provides standards for county streets/roads at locations where culverts and bridges are constructed. When these structures are designed within a roadway crossing, the SDCM requires they be designed to provide certain capacities so that overtopping of the roadway is avoided or minimized.

   Culverts must be designed to manage both the 10- and 100-year floods. Although culverts are allowed to be submerged at the inlet, maximum headwater standards apply. Culverts must typically convey the 10-year flood without overtopping. Beyond that, the 100-year flood is subject to overtopping at maximum depths specified in the SDCM, based on road classification.

   Publicly owned and maintained bridges (i.e., a conventional clear span bridge with a superstructure and foundational supports) must convey the 100-year flood with additional freeboard above the water surface elevation. Assuming this design is feasible and cost-effective, this typically rules out the possibility of any overtopping due to backwater conditions or limited capacity.

Other Roadway-Specific Standards Addressed in the Current SDCM

There are two sections in the SDCM that address roadway design other than roadway capacity and cross drainage structures: Section 704.5, Roadside Ditches for Rural Roads and Section 900, which generally covers allowable drainage encroachments on public roads.

Section 704.5 of the manual includes criteria for the design of roadside ditches, which is more or less the rural equivalent of providing street capacity to rural roads. Ditches are required to carry the 5-year storm runoff without freeboard. Whenever a channel lacks sufficient capacity, the manual states that a storm sewer system shall be required.

Although Section 900 of the manual covers multiple drainage impacts to streets resulting in different types of inundation (i.e., sheet flow, runoff in the gutter, ponding and cross flows), the discussion and supporting materials assume that urban street sections with curb and gutter are the norm for evaluating overtopping in a roadway. Because most mountain and rural roads lack capacity for carrying runoff, the majority of this section is not applicable to design of county roadways in the mountains. It's also worth noting that Section 902 of the manual states the primary function of streets is for traffic movement and that drainage functions must not interfere with traffic functions in the roadway.

Overtopping Criteria in Other Counties

A cursory review of criteria manuals in other neighboring counties shows that the Boulder County manual, despite its age, is very similar in terms of the criterion used that specifically applies to roadway overtopping. The counties whose criteria manuals were checked include Jefferson, Larimer, Douglas, Gilpin and El Paso.

What is common is that other counties do not have criteria that identify a standard for allowable overtopping on a roadway corridor, existing or otherwise. What is mostly the same, by comparison, are the standards for depth at curbs (roadway capacity) not exceeding the 10-year flood and maximum overtopping limits at cross structures (bridges/culverts) for the 10- and 100-year flood events.

Below are some observations from other county criteria manuals:

- Douglas County's manual, in Chapter 7 (Street Drainage) notes that, "allowable cross-street flow or overtopping at culvert crossings is limited by the criteria provided in Chapter 11, Culverts and Bridges."

- El Paso County has similar overtopping standards as Boulder County and also states in Section 6.4.1 (Design Frequency Overtopping Criteria), "When flows are allowed to overtop certain roadway classifications, adequate embankment protection must be employed to prevent the roadway from eroding and potential failure."

- The Jefferson County SDCM states in Section 11.5, (Culvert Sizing Criteria), "In addition to this policy [for proper culvert sizing], a criteria requiring that no street overtopping occur for a 10-year frequency storm has been established."

Conclusion

Except at bridge and culvert crossings and urban streets (capable of carrying storm runoff), the SDCM does not include a policy provision or specific standard for maximum overtopping of new and reconstructed roadways within a local drainage system.

Other criterion in the SDCM includes references to designing for a minor storm with a 5-year recurrence for roadway capacities (and roadside ditches) and a 10-year recurrence interval for structures at waterway crossings. However, since many county roads are rural in nature and in the mountains, utilizing roadway capacity is nearly impossible.

The primary challenge for the county in rebuilding damaged roads – most of which exist in canyons and/or flash flood corridors – is how to uniformly apply standards for flood control and resiliency for years to come. And while the SDCM does a good job covering design criteria for managing drainage in roadways, it is mostly unclear on how to manage roads in drainageways.

Recommendation

The SDCM is relatively old and outdated and contains mostly policies and standards for urbanized areas. It is evident that a thorough update and revision of the manual is necessary and, as a result, this department will initiate solicitation of proposals for a re-write of the manual very soon. This update will take into consideration the inclusion of policies dealing with flood control on and adjacent to rural and mountain roadways. Alternatively, the updated manual may reference other standards specific to roadway designs that take into consideration safety, emergency access and maximum overtopping limits.

In the meantime, whenever possible, collector roads should only be allowed to overtop for storms greater than a 10-year recurrence. For arterial roadways, a minimum driving lane of 10 feet should be available during the 10-year storm. Overtopping during a 100-year storm is allowable.