Technical Memorandum

To: **Electronic Distribution Recipients**

From: **Mark Gieseke, P.E.** Electronic Signature on file
Assistant Commissioner, Engineering Services

Subject: Storm Drain Design Frequency and Catch Basin Spacing

Expiration

This Technical Memorandum supersedes Technical Memorandum 16-05-B-02 and will expire on October 11, 2026 unless superseded or placed into the MnDOT Drainage Manual prior to that date.

Implementation

The provisions of this Technical Memorandum apply to Trunk Highway Storm Drain Systems. The design guidance in this Technical Memorandum is effective immediately for projects in the early stages of the preliminary design phase and may be incorporated into projects in a more advanced design phase.

Introduction

Storm drain design frequency and catch basin spacing criteria are used in the design of storm drain systems. Questions regarding interpretation of the guidance provided in the August 2000 edition of the MnDOT Drainage Manual are intended to be addressed by this Technical Memorandum. This Technical Memorandum adopts AASHTO criteria for maximum spread for lower speed roads and major sag definition, modifies the allowable spread to use both maximum spread and minimum clear lane requirements, and clarifies previous guidelines.

Purpose

This Technical memorandum is intended to update MnDOT spread criteria to make more consistent with AASHTO recommendations and to clarify policy relating to design frequency, allowable spread, and placement of catch basins and bridge deck drains contained in the August 2000 edition of the MnDOT Drainage Manual.

Guidelines

The minimum design frequency for storm drains and the allowable spread of water onto the roadway shall be in accordance with the criteria in Table 1 and subsequent guidance. The allowable spread for travel lanes must meet both the Maximum Spread and Minimum Clear Lane requirements from Table 1. A higher design frequency (longer recurrence interval) than the minimum design frequency shown in Table 1 may be used if justified by consideration of both potential risks and costs and approved by District Hydraulics/Water Resources Engineer.

Determine the allowed spread for travel lanes by calculating both the maximum spread and the minimum clear lane spread (if applicable) from Table 1. The calculated spread for the minimum clear lane requirement is the shoulder width plus the travel lane width minus the required clear lane width. **The allowed spread is the lesser of the maximum spread [1] and minimum clear lane spread [2].**

TABLE 1: DESIGN FREQUENCY, MAXIMUM SPREAD AND MINIMUM CLEAR LANE REQUIREMENTS FOR TRAVEL LANES

HIGHWAY TYPE	AADT	MINIMUM DESIGN FREQUENCY	DESIGN SPEED (mph)	SHOULDER WIDTH	MAXIMUM SPREAD[1]	MINIMUM CLEAR LANE[2]
Interstate	ALL	10 Year	All	All	Shoulder	Not Applicable
Interstate – Major Sag	ALL	50 Year	All	All	Shoulder + 3 feet	Keep 8 feet of travel lane clear
US and State	≥5000	10 Year	>45	≥ 8 feet	Shoulder	Not applicable
				< 8 feet	8 feet	Keep 8 feet of travel lane clear
US and State	≥5000	10 Year	≤ 45	≥ 5 feet	Shoulder + 3 feet	Not applicable
				< 5 feet	8 feet	Keep 6 feet of travel lane clear
US and State – Major Sag	≥5000	50 Year	All	All	½ Travel lane + shoulder	Keep 6 feet of travel lane clear
US and State	<5000	5 Year	>45	≥ 8 feet	Shoulder	Not applicable
				< 8 feet	8 feet	Keep 8 feet of travel lane clear
US and State	<5000	5 Year	≤ 45	≥ 5 feet	Shoulder + 3 feet	Not applicable
				< 5 feet	8 feet	Keep 6 feet of travel lane clear

- Shoulder width is the distance from the face of the curb or barrier to the edge of the travel lane and includes the gutter. For purposes of this Technical Memorandum, the shoulder width also includes the parking lane, and bicycle lane width(s) located between the travel lane and the curb.
- Travel lane is the designated portion of a roadway intended to carry a lane of through traffic. For purposes of this Technical Memorandum, when Table 1 is called out below for the other types of lanes, use that lane width value as the travel lane width.
- Clear lane is the width of the travel lane adjacent to a shoulder with a curb or concrete barrier that will not be covered by ponded water during the design event. Spread is not allowed on travel lanes that are not adjacent to a shoulder, curb, or median barrier for the design frequency.

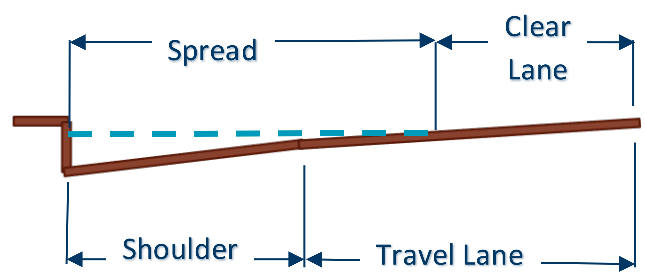

Figure 1: Spread, Clear Lane, Shoulder and Travel Lane Description for use with Table 1.

- AADT is the projected 2-way Annual Average Daily Traffic in vehicles per day.
- Design Frequency is the recurrence interval of the design discharge where recurrence is the average number of years between occurrences of a discharge or rainfall that equals or exceeds the given magnitude. A higher design frequency has a longer recurrence interval resulting in a less frequent event with a larger discharge.

Depth of Water at Curb

Compare the depth of water at the curb for the allowable spread to the curb height. If the water depth exceeds the curb height, review impacts and adjust calculations if necessary to account for potential changes to inlet capture.

US and State Highway Turn Lanes

Design Frequency: Use Table 1 with US and State highway AADT.
Allowable Spread: Keep 6 feet of turn lane clear.

Interstate, US and State Highway Ramps and Loops

Design Frequency: Use Table 1 Interstate criteria for Interstate ramps/loops or US and State highway AADT criteria for US and State highway ramps/loops. Use the higher design frequency if the connecting highways have different minimum design frequencies.
Allowable Spread: Keep 8 feet clear for single lane ramps/loops. Use Table 1 US and State highway criteria with the ramp/loop design speed if there are multiple lanes for Interstate, US and State highway ramps/loops.

Collector/Distributor and Auxiliary Lanes

Design Frequency: Use Table 1 for Interstate or US and State highway AADT.
Allowable Spread: Use Table 1 US and State highway criteria for both Interstate and US and State highway collector/distributor and auxiliary lanes.

Frontage Roads and Local Streets

MnDOT Frontage Roads Design Frequency and Allowable Spread: Use Table 1 US and State highway criteria with the frontage road design speed and AADT.

Local Frontage Roads and Streets Design Frequency and Allowable Spread: Use criteria from the State Aid Manual Allowable Spread Table as a minimum if the road is on the State Aid System; otherwise use criteria established by the local road authority.

Roundabouts

Design Frequency: Use Table 1 based on the connecting roadway with the higher design frequency.
Allowable Spread: Use Table 1 US and State highway criteria for the connecting roadway with the highest design speed and AADT. Use the travel lane and shoulder widths of the roundabout.

Use additional inlets to limit runby flow across connecting roadways.

Managed Lanes

Design Frequency and Allowable Spread: Use Table 1 for Interstate or US and State highway design speed and AADT.

Sag Points
A major sag is a low point where water can pond 2 feet deep or more. The District Hydraulics/Water Resources engineer can approve use of 1 foot or more of ponding as the major sag definition for a project when justified. Justification can include risk factors such as high AADT, high speed, potential flood impacts or other risk factors.

At least one flanking inlet is required at a major sag. Flanking inlets on each side of a major sag inlet are preferred and will result in a more resilient drainage system. The flanking inlet location should be based on Table 8.4 of the Drainage Manual. For major sag points, the flanking inlets are added as a safety factor and are not considered as intercepting flow to reduce the runby to the sag point.

For trunk highways with AADT <5000 and local roads, consider designing the storm drain system for sag points at critical locations for a 50 year design frequency to limit water ponding to a depth less than 2 foot on roads that are otherwise passable. If a 50 year design frequency is not feasible for these roads, then consider a 10 year design frequency for major sag points.

For all sag points, it is recommended that combination grate/curb openings be utilized. If a grate alone is used at sag point, assume a portion of the grate is clogged by debris. A reasonable assumption is that the grate is half clogged with debris.

For sag point inlets on bridges, assume all the deck drains on the bridge upstream of the inlet(s) are half clogged with debris.

Storm drains should be designed to take into consideration potential damage to adjacent properties.

Additional Inlet Locations
There are a number of locations where inlets are necessary with little regard to computed spread or contributing drainage area. Examples of some, but not all, locations are as follows:

- Sag points in the gutter grade
- Upstream of cross walks
- Upstream of median breaks, entrances/exit ramp gores, and street intersections
- Immediately upstream and downstream of bridges
- Immediately upstream of cross slope reversals
- On side streets at intersections
- At the end of channels in cut sections
- Behind curbs, shoulders, or sidewalks to drain low areas
- Where necessary to collect snow melt.

Bridge Deck Drainage
Design frequency and Allowable Spread: Use Table 1.

The primary best practice for bridge deck design is to eliminate or minimize the use of an under deck drainage system or piping. Secondly, it is to minimize the amount of flow over the joints at the ends of the bridge. Best practices do not override design frequency and allowable spread criteria.

Specific design practices that can reduce the need for bridge storm drain systems and improve deck drainage performance include:

- Avoid zero gradients, sag vertical curves and superelevation transitions with flat pavement sections.
- Minimize or avoid the need for deck drains to the maximum extent possible with the bridge deck geometry design by modifying cross slope breaks, longitudinal slope/profile adjustments, or increased shoulder width.
- Minimize or avoid use of below deck piped drainage systems due to capital and maintenance costs, and expected low reliability due to lack of durability, clogging, segments becoming separated and/or unattached.
- Consider the following during deck drain positioning:
    - Position drains so they do not discharge directly into a waterway.
    - Position drains directly above an appropriate outlet point to eliminate piping and bends.
    - Position drains without piping systems so that water does not splash onto beams or piers.
    - Provide a riprap splash pad or erosion protection at the drainage outlet points.
- Collect highway drainage prior to it reaching the bridge.
- Include runoff management and erosion protection at bridge ends.

Questions

Any questions regarding the technical provisions of this Technical Memorandum can be addressed to either of the following:

Andrea Hendrickson, State Hydraulics Engineer
Andrea.Hendrickson@state.mn.us, (651) 366-4466

Erik Brenna, Assistant State Hydraulics Engineer
Erik.Brenna@state.mn.us, (651) 366-4536

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards Unit, DesignStandards.DOT@state.mn.us. A link to all active and historical Technical Memoranda can be found at http://techmemos.dot.state.mn.us/techmemo.aspx.

To add, remove or change your name on the Technical Memoranda mailing list, please visit the web page http://techmemos.dot.state.mn.us/subscribe.aspx

-END-