

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

DETAILED STEPS FOR DETERMINING STORMWATER DETENTION ALLOWABLE RELEASE

RATE AND REQUIRED DETENTION STORAGE

Submit all supporting drawings and calculations.

I. Determination of Allowable Release Rate - Undeveloped Site: (Delineate total, developed, undeveloped and unrestricted areas on a grading plan)

- 1. Area of site..... _____ acres
- 2. Average ground slope..... _____ feet/foot
- 3. Longest overland flow distance (show for undeveloped site)..... _____ feet
- 4. Overland flow time of concentration (Use Attach. 3)..... _____ minutes
- 5. Average slope of channelized flow (See Note a)..... _____ feet/foot
- 6. Channelized flow distance (See Note a)..... _____ feet
- 7. Channelized flow time of concentration (See Note a)..... _____ minutes
- 8. Total time of concentration (line 4 + line 7)..... _____ minutes
- 9. Rainfall intensity for three-year storm,
(Use Attach. 2 for the time duration on line 8)..... _____ inches/hr.
- 10. Gross allowable release rate, $Q=CIA=0.15 \times \text{line 9} \times \text{line 1}$ _____ cfs
(Use this release rate for calculations in Column D of Attach.1)
- 11. Unrestricted release rate, $Q_{un}=C_{un} I_{un} A_{un}$ (C_{un} for developed state,
 I_{un} for 100 year storm, A_{un} for unrestricted site)..... _____ cfs
- 12. Net allowable release rate (line 10 - line 11)..... _____ cfs

Note a: For flow in a well defined channel, determine time of concentration from measured lengths, cross-sections and slopes and submit supporting calculations and drawings.

II. Determination Required Detention Basin Capacity - Developed Site:

- 13. Impervious drainage area*..... _____ acres
- 14. Impervious wet pond area*..... _____ acres
- 15. Pervious drainage area*..... _____ acres
- 16. Composite runoff coefficient**..... _____
- 17. Determine detention basin capacity for actual release rate. See
detailed example attached. Required reservoir..... _____ acre-feet

*Unrestricted areas are excluded here.

** See MWRD info sheet on runoff coefficient determination (available at www.mwrd.org)

III. Bypass Rate through Development Site from Upstream Area:

Delineate bypass areas on USGS map or grading plans. The following steps are applicable to bypass flow over a detention facility weir, or bypass flow around the detention system.

A. Determination of Required Bypass Rate:

- 18. Total area upstream..... _____ acres
- 19. Ultimate impervious area..... _____ acres
- 20. Ultimate pervious area..... _____ acres
- 21. Composite runoff coefficient (ultimate)..... _____
(Minimum of 0.35 per MWRDGC Manual of Procedures)
- 22. Design storm frequency for the upstream area..... _____ year
(Design storm frequency is determined by local ordinance; if no local requirement is established, use 5-year storm frequency)
- 23. Time of concentration, for the upstream area at point of entry
(upstream area to be considered as developed) (By same method as
line 8)..... _____ minutes
- 24. Design storm intensity for above duration..... _____ inches/hr
- 25. Required bypass rate (line 18 x line 21 x line 24)..... _____ cfs

B. Determination of Required Size of Bypass System:

- 26. Bypass system* will be open channel/closed conduit (cross out
inappropriate case)..... _____
- 27. Water cross-section area for discharge in line 25..... _____ sq. ft.
- 28. Wetted perimeter for area in line 27..... _____ feet
- 29. Hydraulic radius (line 27 ÷ 28)..... _____ feet
- 30. Line 29 to the 2/3 power..... _____
- 31. Invert slope..... _____ feet/foot
- 32. Line 31 to the 1/2 power..... _____
- 33. Manning's roughness coefficient used (n)..... _____
- 34. Design bypass capacity..... _____ cfs
(1.49 x line 27 x line 30 x line 32) ÷ (line 33)

$$\text{Manning's Equation: } Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

*For weir, submit supporting calculations and details.

Attachments

- 1. Determination of Required Detention Storage
- 2. Rainfall Intensity Data (3-year storm and 100-year storm)
- 3. Overland Flow Time of Concentration

DETERMINATION OF REQUIRED DETENTION STORAGE

SAMPLE EXAMPLE

(Attachment 1)

Assumed Data: Tributary area = 80 acres; composite runoff coefficient C (for developed area) = 0.75; no unrestricted release rate area; time of concentration (for undeveloped area) = 75 min. 3-year rainfall intensity (for tc = 75 min.) = 1.52 in/hr (from chart below).

A		B	C	D	E
Duration Time		Intensity for 100-yr Storm	Inflow Rate (Line 1 x Line 16 x Col. B)	Stored Rate Col. C - Line 12	Reservoir Size (Col. A (Hrs) x Col. D -:- 12)
(Hrs.)	(Min.)	(In/Hr.)	(cfs)	(cfs)	(Acre-Ft)
0.17	10	7.60	456	438	6.1
0.33	20	5.50	331	313	8.5
0.50	30	4.40	264	246	10.1
0.67	40	3.70	223	205	11.9
0.83	50	3.20	192	174	11.9
1.0	60	2.80	168	150	12.4
1.5	90	2.10	125	107	13.2
2.0	120	1.70	103	85	14.0 Max
3.0	180	1.20	72	56	13.8
4.0	240	1.00	60	42	13.7

RAINFALL INTENSITY DATA

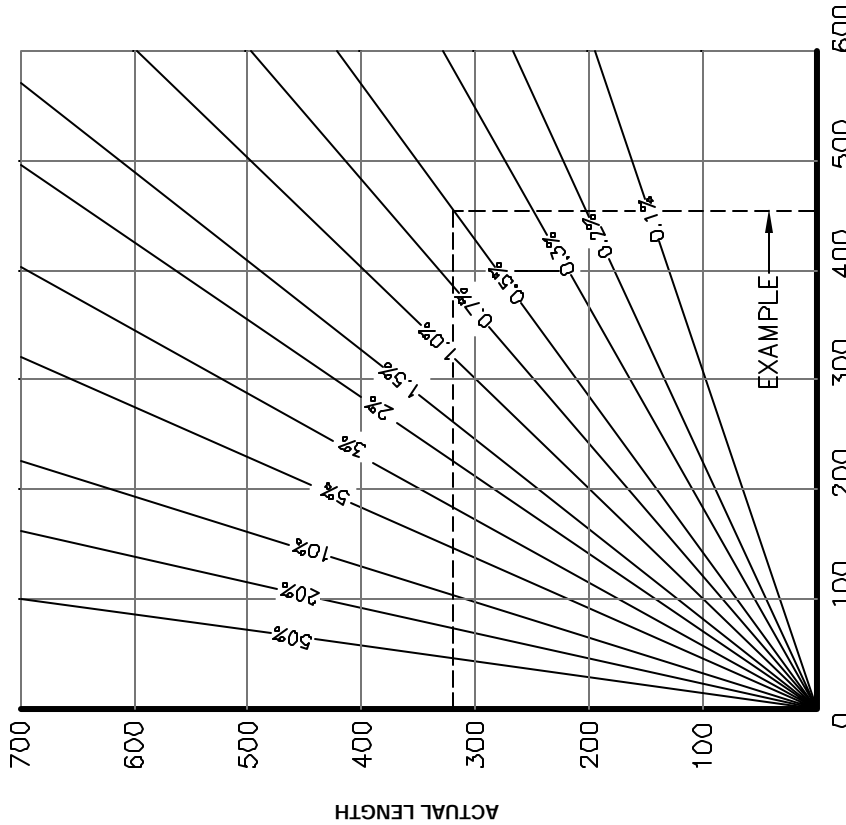
DATA SOURCE: U.S. WEATHER BUREAU TECHNICAL PAPER NO. 40

(Attachment 2)

Storm Duration (minutes or hours)		Rainfall Intensity (inches per hour)		Storm Duration (minutes or hours)		Rainfall Intensity (inches per hour)	
		3-Year	100-Year			3-Year	100-Year
0.17 hrs.	10 min.	4.3	7.6	10 hrs.		0.27	0.49
0.33 "	20 "	3.0	5.5	11 "		0.25	0.46
0.50 "	30 "	2.45	4.40	12 "		0.23	0.43
0.67 "	40 "	2.15	3.70	13 "		0.22	0.40
0.83 "	50 "	1.85	3.20	14 "		0.20	0.38
	1 hr.	1.67	2.80	15 "		0.19	0.36
	1.5 "	1.27	2.10	16 "		0.18	0.34
	2 "	1.00	1.70	17 "		0.17	0.33
	3 "	0.73	1.20	18 "		0.16	0.31
	4 "	0.58	1.00	19 "		0.16	0.30
	5 "	0.48	0.84	20 "		0.15	0.29
	6 "	0.42	0.73	21 "		0.15	0.28
	7 "	0.37	0.65	22 "		0.14	0.27
	8 "	0.33	0.58	23 "		0.14	0.26
	9 "	0.30	0.53	24 "		0.13	0.25

ATTACHMENT 3 OVERLAND FLOW TIME OF CONCENTRATION

FIGURE 3-A

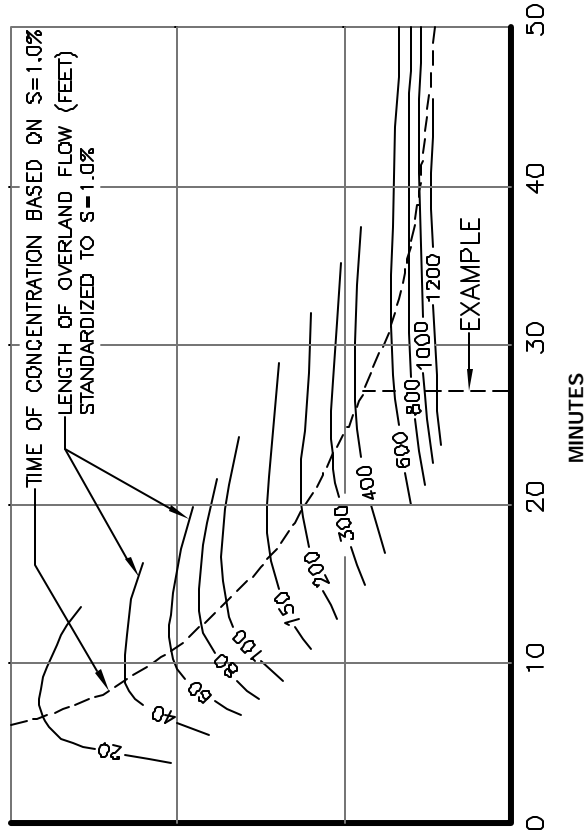


NOTE: LENGTH STANDARDIZED TO S=1.0 %

WHEN OVERLAND FLOW DISTANCE IS GREATER THAN 1000 FEET, USE

$$T = 1.49 \frac{(1.1 - C) D}{\sqrt{S}}$$

FIGURE 3-B



EXAMPLE:

FIND THE TIME OF CONCENTRATION OF 320 FEET OVERLAND FLOW AT S=0.5%. IN FIG. 3-A, ENTER ACTUAL LENGTH 320 FEET. GO TO S=0.5%; READ 450 FEET ON STANDARDIZED LENGTH AXIS. ENTER 450 FEET IN FIG. 3-B. READ 27 MINUTES ON HORIZONTAL AXIS.

SOURCE: DEPARTMENT OF THE ARMY TECHNICAL MANUAL, TM5-820-1.

WHERE: S = AVERAGE SLOPE, %;

D = OVERLAND FLOW DISTANCE, FEET;

C = RUNOFF COEFFICIENT (USE C=0.15 FOR MWRD REQUIREMENTS);

T = TIME OF CONCENTRATION, MINUTES

FROM FEDERAL AVIATION ADMINISTRATION, AIRPORT DRAINAGE