PEAK DISCHARGE COMPUTATION FORM 4-1

CALCULATED BY: _____ **DATE:** _____
CHECKED BY: _____ **DATE:** _____

PROJECT NAME: _____
STATE PROJECT NUMBER: _____

AREA NUMBER: ATTACH WATERSHED MAP
LOCATION DESCRIPTION:

STATION _____ **TO** _____

DRAINAGE AREA = _____ **ACRES** _____ **MI²**

DESIGN RETURN PERIOD: _____ **YEARS**

RATIONAL METHOD **1 acre - 200 acres**	**TR - 55** **5 acres - 16,000 acres**	**USGS METHOD** **0.1 square miles - 8,371 square miles**
TIME OF CONCENTRATION OVERLAND FLOW SHEET FLOW $T_{t\,sh}$ = _____ Min. SHALLOW CONCENTRATED FLOW $T_{t\,sc}$ = _____ Min. CHANNEL FLOW $T_{t\,ch}$ = _____ Min. $T_c = T_{tsh} + T_{tsc} + T_{tch}$ = _____Min. Note: all three flow segements may not be present. Rainfall Intensity i = _____ in/hr C A CA _____ _____ _____ _____ _____ _____ _____ _____ _____ Total _____ _____ Weighted Coefficient "C" = _____ C = • (CA) / • A	INFO FROM WORKSHEET 4-1 CN = _____ 24 hr P = _____ in. Runoff Depth Q = _____ in. INFO FROM WORKSHEET 4-2 T_c = _____ hr. INITIAL ABSTRATION (Table 4-13) I_a = _____ in. I_a / P = _____ UNIT PEAK DISCHARGE q u USE Tc AND I a / P WITH CHART 4-7 = _____ cfs / mi² / in POND AND SWAMP AREAS Percent of watershed = _____ % (Table 4-8) Factor F_p = _____ PEAK DISCHARGE $q_p = q_u$ (A in mi²) Q F_p	REGION RANGES: North: 0.13 mi² to 1,516 mi² South: 0.10 mi² to 8,371 mi² East: 0.22 mi² to 1,486 mi² REGION: FROM MAP 4-9 NORTH ☐ SOUTH ☐ EAST ☐ EQUATION: FROM TABLE 4-15 OR TABLE 4-16 Eqn:_____
Q = _____cfs	q_p = _____cfs	Q = _____cfs

SELECTED DESIGN DISCHARGE

Q = _____ cfs

REASON FOR SELECTION (BASED ON COMPARISON) SEE SECTION 4.3.4

_____
_____
_____

PEAK DISCHARGE COMPUTATION FORM 4-2

CALCULATED BY: _____ **DATE:** _____
CHECKED BY: _____ **DATE:** _____

PROJECT NAME: _____
STATE PROJECT NUMBER: _____

AREA NUMBER: ATTACH WATERSHED MAP
LOCATION DESCRIPTION:

STATION _____ **TO** _____

DRAINAGE AREA =_____ **ACRES** _____ **MI^2**

DESIGN RETURN PERIOD: _____ **YEARS**

FLOOD INSURANCE STUDY DATA	UNITED STATES ARMY CORP OF ENGINNERS DATA	USGS METHOD 0.1 square miles - 8,371 square miles
FIS DATE: _____	FIS DATE: _____	REGION RANGES: North: 0.13 mi ^{2} to 1,516 mi ^{2} South: 0.10 mi ^{2} to 8,371 mi ^{2} East: 0.22 mi ^{2} to 1,486 mi ^{2}
COMMUNITY NAME AND NUMBER: _____	COMMUNITY NAME AND NUMBER: _____	
LOCATION: _____	LOCATION: _____	REGION: FROM MAP 4-9
METHOD: RAINFALL RUNOFF MODEL ☐ REGIONAL REGRESSION EQUATIONS ☐ ANALYSIS OF GAGE RECORDS ☐ OTHER (PROVIDE DESCRIPTION) ☐	METHOD: RAINFALL RUNOFF MODEL ☐ REG. REGRESSION EQUATIONS ☐ ANALYSIS OF GAGE RECORDS ☐ OTHER (PROVIDE DESCRIPTION) ☐	NORTH ☐ SOUTH ☐ EAST ☐
DESCRIPTION: _____	DESCRIPTION: _____	EQUATION: FROM TABLE 4-15 OR TABLE 4-16 Eqn:_____
ATTACH COPY OF SUMMARY OF DISCHARGES TABLE FROM FIS	ATTACH COPY OF DATA OF FROM USACE	
Q = _____cfs	Q = _____cfs	Q = _____cfs

SELECTED DESIGN DISCHARGE

Q = _____ cfs

REASON FOR SELECTION (BASED ON COMPARISON) SEE SECTION 4.3.4 _____

WORKSHEET 4-1 RUNOFF CURVE NUMBER DETERMINATION

CALCULATED BY: _____ DATE: _____
CHECKED BY: _____ DATE: _____

PROJECT NAME: _____
STATE PROJECT NUMBER: _____

Soil Name	Hydrologic Group	Cover Description percent impervious unconnected/connected impervious area ratio	CN Source			Area in mi^2	CN X Area
			Table 4-9	Table 4-10	Chart 4-5		

one CN source per line

Weighted CN = Total CN X Area / Total Area

Totals → [ ] [ ]

Weighted Curve Number → [ ]

	Storm #1	Storm #2
Return Period in years		
24 Hour Rainfall Depth, P in inches		
Runoff Depth, Q in inches		

24 hour Rainfall Depth from Table 4-11, or Map 4-3 through Map 4-8
Runoff Depth from Table 4-12 or Chart 4-6

WORKSHEET 4-2 TIME OF CONCENTRATION COMPUTATION

CALCULATED BY: _____ **DATE:** _____	**PROJECT NAME:** _____
CHECKED BY: _____ **DATE:** _____	**STATE PROJECT NUMBER:** _____

Space for two sections per flow type can be used for each worksheet.
Include a map, schematic or description of the flow segements

OVERLAND FLOW SEGEMENT, SHEET FLOW TYPE

Section ID					
Surface description (Table 4-5)					
Roughness coeff. n (Table 4-5)					
Flow length L in ft (should be ≤ 100 ft)					
2 Yr 24 Hr rainfall depth P in inches (Map 4-3)					
Land slope S in ft / ft					
Computed travel time T_t in hours		+		=	

OVERLAND FLOW SEGEMENT, SHALLOW CONCENTRATED FLOW TYPE

Section ID					
Cover type					
Surface cover coefficient in equation					
Watercourse slope S in ft / ft					
Average velocity V in ft / s (Chart 4-7)					
Flow length in ft					
Computed travel time T_t in hours		+		=	

note: overland flow (sheet flow + shallow concentrated flow should be < 200' urban areas, < 400' rural areas)

CHANNEL FLOW SEGEMENT

Section ID					
Cross sectional flow area A in ft^2					
Wetted flow perimter P in ft					
Hydraulic radius R = A / P in ft					
Channel slope S in ft / ft					
Mannings roughness coeff. n (Table 4-7)					
Velocity from Mannings equation, V in ft / s					
Flow length L in ft					
Computed travel time T_t in hours		+		=	

Watershed time of concentration T_c in hours _____

DRAINAGE COMPUTATION FORM 5-1
INLET SPACING

PROJECT NAME _____

PROJECT # _____ SHEET_____ OF _____

INLET ID.		FLOW IN THE GUTTER							GUTTER SECTION PROPERTIES						GUTTER DISCHARGE				INLET CAPACITY		REMARKS
			TIME OF CONCENTRATION																		
INLET NUMBER	STATION	DRAINAGE AREA	SHEET FLOW	SHALLOW CONCEN. FLOW	TOTAL	RAINFALL INTENSITY	RUNOFF COEFICIENT	= C I A	LONGITUDINAL GUTTER SLOPE	GUTTER CROSS SLOPE	ROADWAY CROSS SLOPE	GUTTER WIDTH	INLET TYPE	INLET DIMENSIONS	PREV IOUS INLET BYPASS FLOW	TOTAL GUTTER FLOW $Q_{10} + Q_B$	GUTTER FLOW SPREAD	GUTTER FLOW DEPTH	INTERCEPTED FLOW	INLET BY PASS FLOW	
		A	t_t	t_t	T_c	i	C	Q_{10}	S_L	S_W	S_X	W			Q_B	Q	T	d	Q_i	Q_B	
		acres	min	min	min	in/hr		cfs	ft/ft	ft/ft	ft/ft	feet		feet x feet	cfs	cfs	feet	feet	cfs	cfs	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	

DRAINAGE COMPUTATION FORM 5-2
STORM SEWER, HYDRAULIC DESIGN

PROJECT NAME _____
PROJECT NUMBER _____

DESIGNER_____ DATE_____
REVIEWER_____ DATE_____

SHEET_____ OF _____

LINE	PIPE ID.		PIPE FLOW (AT THE FROM POINT)							PIPE PROPERTIES						PIPE FLOW PROPERTIES				SYSTEM FLOW TIME		SELF CLEANING	
	FROM POINT	TO POINT	FLOW TO INLET DRAINAGE AREA	RUNNOFF COEFICIENT (WEIGHTED?)	CA		TIME OF CONCENTRATION	RAINFALL INTENSITY	RUNOFF = C I A	LONGITUDINAL PIPE SLOPE	INVERT ELEVATIONS		PIPE LENGTH	PIPE DIAMETER	80% OF PIPE DIAMETER	PIPE FLOW DEPTH	PIPE FLOW VELOCITY	PIPE FLOW CRITICAL DEPTH	SUBCRITICAL OR SUPERCRITICAL FLOW	PIPE FLOW TIME	LONGEST OVERALL TIME OF CONCENTRATION	15% OF PIPE DIAMETER	PIPE FLOW VELOCITY
					INCREMENT	ACCUMULATED					UPPER END FROM POINT	LOWER END TO POINT											
			A acres	C	CA acres	CA acres	t_C min	i_{10} in / hr	Q_{10} cfs	S ft / ft	feet	feet	feet	D feet	0.8D feet	d feet	V ft / s	d_{CR} feet	SUB SUP	min	t_C min	0.15D feet	$V_{15\%}$ ft / s
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							
13																							
14																							
15																							

DRAINAGE COMPUTATION FORM 5-3
STORM SEWER, HYDRAULIC GRADE LINE

PROJECT NAME _____
PROJECT NUMBER _____

DESIGNER_____ DATE_____
REVIEWER_____ DATE_____

SHEET_____ OF _____

LINE	INLET LABEL	SUBCRITICAL OR SUPERCRITICAL CURRENT SEGMENT	PIPE OUTLET WATER SURFACE ELVEV.	MAJOR LOSS					MINOR LOSS				TOTAL HEAD LOSS	WATER SURFACE ELEV. (HGL)	STRUCTURE TOP ELEVATION (SURCHARGE CHECK)	ENERGY GRADE LINE ELEV. (EGL)	REMARKS
				SEGMENT PIPE DIAMETER	SEGMENT PIPE FLOW	SEGMENT PIPE LENGTH	FRICTION SLOPE	FRICTION LOSS	FLOW VELOCITY FOR SEMENT PIPE	SEGMENT PIPE VELOCITY HEAD	MINOR LOSS COEFFICIENT	ACCESS HOLE OR INLET LOSS					
		SUB SUP	feet	D_S feet	Q_S cfs	L_S feet	S_f ft / ft	H_f feet	V_S ft / s	$V_S^2 / 2g$ ft / s	K	H_{aho} feet	H feet	feet	feet	feet	
	24	25	26	27	28	29	30	31	32	33	34 & 57	35	36	37	38	39	
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	

DRAINAGE COMPUTATION FORM 5-4
STORM SEWER, MINOR LOSSES

PROJECT NAME _____
PROJECT NUMBER _____

DESIGNER_____ DATE_____
REVIEWER_____ DATE_____

SHEET_____ OF _____

LINE	INLET LABEL	SUBCRITICAL OR SUPERCRITICAL NEXT / UPSTREAM SEGMENT	INITIAL HEAD LOSS				FLOW DEPTH LOSS		PIPE DIAMETER CHANGE LOSS		RELATIVE FLOW LOSS				PLUNGING FLOW LOSS		BENCHING FACTOR (ENERGY GAIN)	MINOR LOSS COEFFICIENT	REMARKS
			INLET WIDTH OR ACCESS HOLE DIAMETER	CHANGE IN FLOW ANGLE	SEGMENT PIPE DIAMETER	INITIAL HEAD LOSS COEFF.	FLOW DEPTH IN ACC. HOLE OR INLET	FREE SURFACE / FACTOR FOR FLOW DEPTH	NEXT UPSTREAM SEGMENT PIPE DIAMETER	PRESSURE FLOW / FACTOR FOR PIPE DIAMETER	SEGMENT PIPE FLOW	NEXT UPSTREAM SEGMENT PIPE FLOW	ANGLE BETWEEN ANALYZED SEGMENTS	FACTOR FOR RELATIVE FLOW	DISTANCE OF PLUNGING FLOW	PLUNGING FLOW FACTOR			
		SUB SUP	b feet	Θ deg	D_S feet	K_O	d_Q feet	C_d	D_{NS} feet	C_D	Q_S cfs	Q_{NS} cfs	β deg	C_Q	h_Q feet	C_p	C_B	K	
	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			

DRAINAGE COMPUTATION FORM 6-1
DITCH HYDRAULIC DESIGN

PROJECT NAME _____
PROJECT NUMBER _____

DESIGNER_____ DATE_____
REVIEWER_____ DATE_____

SHEET_____ OF _____

LOCATION		DITCH FLOW (AT THE END STATION)									DITCH PROPERTIES							DITCH FLOW PROPERTIES					MIN. FLOW VEL. (0.5 ft/s)	
				CA		TIME OF CONCENTRATION																		
BEGIN STATION	END STATION	DRAINAGE AREA	RUNNOFF COEFICIENT	INCREMENT	ACCUMULATED	INCREMENT	ACCUMULATED	RECURRENCE INTERVAL*	RAINFALL INTENSITY	RUNOFF = C I A	LONGITUDINAL DITCH SLOPE	BOTTOM WIDTH	FORESLOPE	BACKSLOPE	SOIL TYPE	DITCH LINING	ROUGHNESS COEFFICIENT MANNING'S n	DEPTH	MAXIMUM ALLOWABLE DEPTH	VELOCITY	SHEAR STRESS	MAXIMUM PERMISSIBLE SHEAR STRESS	1/3 DESIGN FLOW DEPTH	DITCH FLOW VELOCITY
		A	C	ΔCA	ΣCA	Δt_c	Σt_c	2-yr. or	i	Q	S						n	d		V	τ		1/3 d	$V_{1/3}$
		acres		acres	acres	min	min	10-yr.	in / hr	cfs	ft / ft	feet						feet	feet	ft / s	psf	psf	feet	ft / s
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

*Ditches shall be designed for a 10-year (10%) storm. If permanent matting is used, then the 2-year (50%) storm shall also be analyzed for the non-vegetated state.

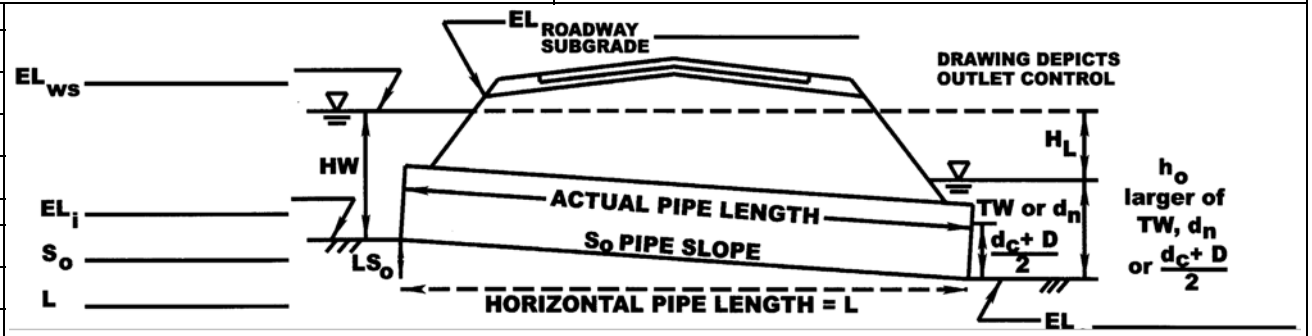
DRAINAGE COMPUTATION FORM 8 - 1
CULVERT DESIGN

PROJECT NAME _____
PROJECT NUMBER _____

STATION_____
DESIGNER_____ DATE_____
REVIEWER_____ DATE_____

OUTLET CHANNEL TAILWATER		
	RETURN PERIOD	TW OR NORMAL DEPTH
DESIGN STORM		
CHECK STORM		

CULVERT FLOWS		
	RETURN PERIOD	FLOW
DESIGN STORM		
CHECK STORM		



CULVERT DESCRIPTION				INLET CONTROL		OUTLET CONTROL										
MATERIAL, ENTRANCE, ROUGHNESS	CULVERT DIAMETER OR SHAPE	TOTAL FLOW	MAX ALLOWABLE HEADWATER	HEADWATER TO DEPH RATIO	HW AT INLET DUE TO INLET CONTROL	TAILWATER OR NORMAL DEPTH IN CHANNEL	CRITICAL DEPTH IN PIPE	PIPE CRITICAL DEPTH & DIAMETER AVERAGE	WSEL AT THE PIPE OUTLET	ENTRANCE LOSS COEFFICIENT	HEAD LOSS DUE TO FLOW THROUGH THE CULVERT	FALL THROUGH THE CULVERT	HW AT INLET DUE TO OULET CONTROL	CONTROLLING HEADWATER	OUTLET VELOCITY	REMARKS
		Q	H_{MAX}	HW_i / D	HW_i	TW, d_n	d_C	$(d_C+D)/2$	h_o	k_e	H_L	$L S_o$	HW_o	HW	V	
		cfs	ft		ft	ft	ft	ft	ft		ft	ft	ft	ft	ft / s	

RECOMMENDATION: