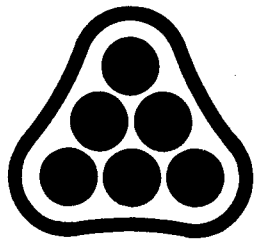
DRAINAGE PLAN
AND
SUPPORTING CALCULATIONS



PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

FOR

WOODBRIDGE 3RD ADDITION

WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
ENGINEERS
1440 E. ENGLISH
WICHITA, KANSAS

FEBRUARY 26, 1986

1440 EAST ENGLISH
WICHITA, KANSAS 67211
(316) 262-2691

```
110 t,woodbridge 3rd addition
120 t,storm sewer system no 100
130 i,  107      0.70      4.80      0.00      0.00      0.00     15.00    165.50
140 i,  106      0.40      1.70      0.00      0.00      0.00     15.00    159.80
150 i,  105      0.40      5.20      0.00      0.00      0.00     15.00    159.80
160 i,  104      0.40      0.40      0.00      0.00      0.00     15.00    160.00
170 m,  103    160.90
180 i,  102      0.40      1.90      0.00      0.00      0.00     15.00    159.40
190 m,  101    159.60
200 m,  100    155.50
210 p,  107  105   460.00   24 0.013  40.00   0.00
220 p,  106  105    30.00   15 0.013 120.00   0.00
230 p,  105  104    60.00   30 0.013  60.00   0.00
240 p,  104  103   120.00   30 0.013  85.00   0.00
250 p,  103  102   350.00   30 0.013   5.00   0.00
260 p,  102  101   170.00   36 0.013  57.00   0.00
270 p,  101  100    65.00   36 0.013  90.00   0.00
280 e
```

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Time: 14:09:13

Input File: wdbr100

woodbridge 3rd addition
storm sewer system no 100

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

Node to Node		C	Tributary Area Area (Ac)	Slope (%)	Length (Ft)	TC(0) (Min)	I(0) (In/Hr)	Q(0) (CFS)	Hydrology Summation TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Conduit Data Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
107	105	0.70	4.80	0.00	0.0	15.00	4.06	13.64	15.00	4.06	13.64	13.64	24"	4.34	460.00	1.77	16.77
106	105	0.40	1.70	0.00	0.0	15.00	4.06	2.76	15.00	4.06	2.76	2.76	15"	2.25	30.00	0.22	15.22
105	104	0.40	5.20	0.00	0.0	15.00	4.06	8.44	16.77	3.89	8.08	24.38	30"	4.97	60.00	0.20	16.97
104	103	0.40	0.40	0.00	0.0	15.00	4.06	0.65	16.97	3.87	0.62	25.00	30"	5.09	120.00	0.39	17.36
103	102	0.00	0.00	0.00	0.0	0.00	0.00	0.00	17.36	3.83	0.00	25.00	30"	5.09	350.00	1.15	18.51
102	101	0.40	1.90	0.00	0.0	15.00	4.06	3.08	18.51	3.74	2.84	27.84	36"	3.94	170.00	0.72	19.23
101	100	0.00	0.00	0.00	0.0	0.00	0.00	0.00	19.23	3.68	0.00	27.84	36"	3.94	65.00	0.28	19.50

Date: 02-[illegible]-1986
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woodbridge 3rd addition
storm sewer system no 100

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
107	0.00363	1.6717	0.0000	0.0000	0.0000	0.0000	0.0000	1.6717	160.5783	165.5000	4.92
106	0.00183	0.0548	0.0000	0.0000	0.0000	0.0000	0.0000	0.0548	158.9614	159.8000	0.84
105	0.00353	0.2120	0.0000	0.0090	0.0000	0.0553	0.5202	0.7965	158.9067	159.8000	0.89
104	0.00371	0.4457	0.0000	0.0020	0.0000	0.1177	0.0576	0.6230	158.1102	160.0000	1.89
103	0.00371	1.3000	0.0000	0.0000	0.0201	0.1880	0.0186	1.5268	157.4872	160.9000	3.41
102	0.00174	0.2962	0.0000	0.0324	0.0000	0.0063	-0.0780	0.2568	155.9604	159.4000	3.44
101	0.00174	0.1132	0.0000	0.0000	0.0120	0.0696	0.0087	0.2036	155.7036	159.6000	3.90
100	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	155.5000	155.5000	0.00

Da 02-1 86
Time: 15:26:17

Input File: wdbr100

woodbridge 3rd addition
storm sewer system no 100

Storm Frequency = 100-Year

* * * HYDROLOGY * * *

Tributary Area									Hydrology Summation				Conduit Data				
Node	to Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC(0) (Min)	I(0) (In/Hr)	Q(0) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
107	105	0.70	4.80	0.00	0.0	15.00	8.97	30.15	15.00	8.97	30.15	30.15	24"	9.60	460.00	0.80	15.80
106	105	0.40	1.70	0.00	0.0	15.00	8.97	6.10	15.00	8.97	6.10	6.10	15"	4.97	30.00	0.10	15.10
105	104	0.40	5.20	0.00	0.0	15.00	8.97	18.66	15.80	8.79	18.29	54.44	30"	11.09	60.00	0.09	15.89
104	103	0.40	0.40	0.00	0.0	15.00	8.97	1.44	15.89	8.77	1.40	55.84	30"	11.38	120.00	0.18	16.06
103	102	0.00	0.00	0.00	0.0	0.00	0.00	0.00	16.06	8.74	0.00	55.84	30"	11.38	350.00	0.51	16.58
102	101	0.40	1.90	0.00	0.0	15.00	8.97	6.82	16.58	8.63	6.56	62.40	36"	8.83	170.00	0.32	16.90
101	100	0.00	0.00	0.00	0.0	0.00	0.00	0.00	16.90	8.57	0.00	62.40	36"	8.83	65.00	0.12	17.02

Input File: wdbr100

woodbridge 3rd addition
storm sewer system no 100

Storm Frequency = 100-Year

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
107	0.01776	8.1705	0.0000	0.0000	0.0000	0.0000	0.0000	8.1705	180.7416	165.5000	-15.24
106	0.00892	0.2677	0.0000	0.0000	0.0000	0.0000	0.0000	0.2677	172.8388	159.8000	-13.04
105	0.01761	1.0568	0.0000	0.0479	0.0000	0.2702	2.6352	4.0101	172.5711	159.8000	-12.77
104	0.01853	2.2239	0.0000	0.0100	0.0000	0.5869	0.2904	3.1113	168.5610	160.0000	-8.56
103	0.01853	6.4865	0.0000	0.0000	0.1005	0.9381	0.0928	7.6179	165.4498	160.9000	-4.55
102	0.00875	1.4878	0.0000	0.1599	0.0000	0.0313	-0.3700	1.3090	157.8319	159.4000	1.57
101	0.00875	0.5689	0.0000	0.0000	0.0605	0.3497	0.0438	1.0229	156.5229	159.6000	3.08
100	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	155.5000	155.5000	0.00

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Project Woodbridge 3rd Add'n

Item Drainage Plan

Check Inlet Sizes:

Node	Q_2	Inlet Condition	Size
107	13.6	Sump	2'x4' Drop Inle
106	2.8	Sump	1 @ 5'
105	8.4	Sump	1 @ 5'
104	0.7	Sump	1 @ 5'
103	-	(Manhole)	-
102	3.1	Sump.	1 @ 5'
101	-	(Manhole)	-
100	-	(End Section)	-

Using Chart 12 Attached, Allowable d = 0.17' (2" dep.)
0.55' (IE to T.C.)
0.72'

USE 1 C.O.W Std Type 1A Curb Inlet (L=5')
@ Nodes 106, 105, 104, 102

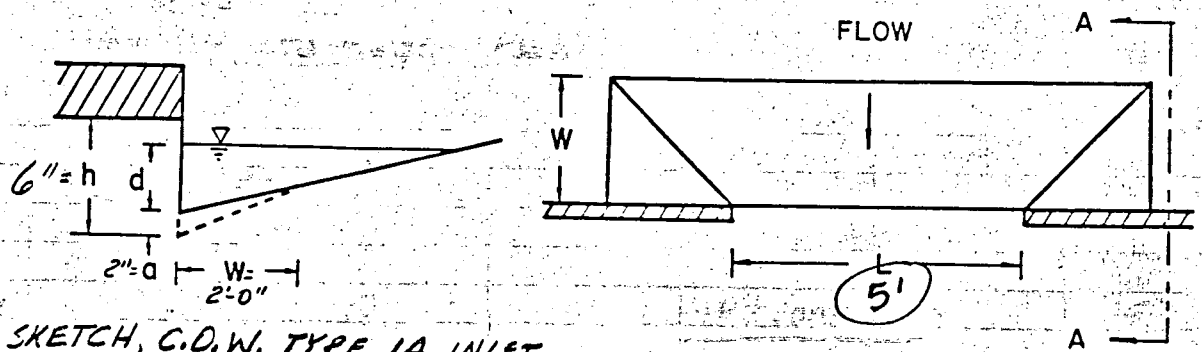
Node 107 Q_2 = 13.6

USE ORIFICE EQ'N $Q = cA\sqrt{2gh}$ where
Q = 13.6
c = 0.6
A = Unknown
g = 32.2 ft/sec²
h = 1.0'

$13.6 = 0.6 \times A\sqrt{64.4}$

A = 2.8 S.F.

USE 1 C.O.W 2'x4' Drop Inlet



DEF. SKETCH, C.O.W. TYPE 1A INLET

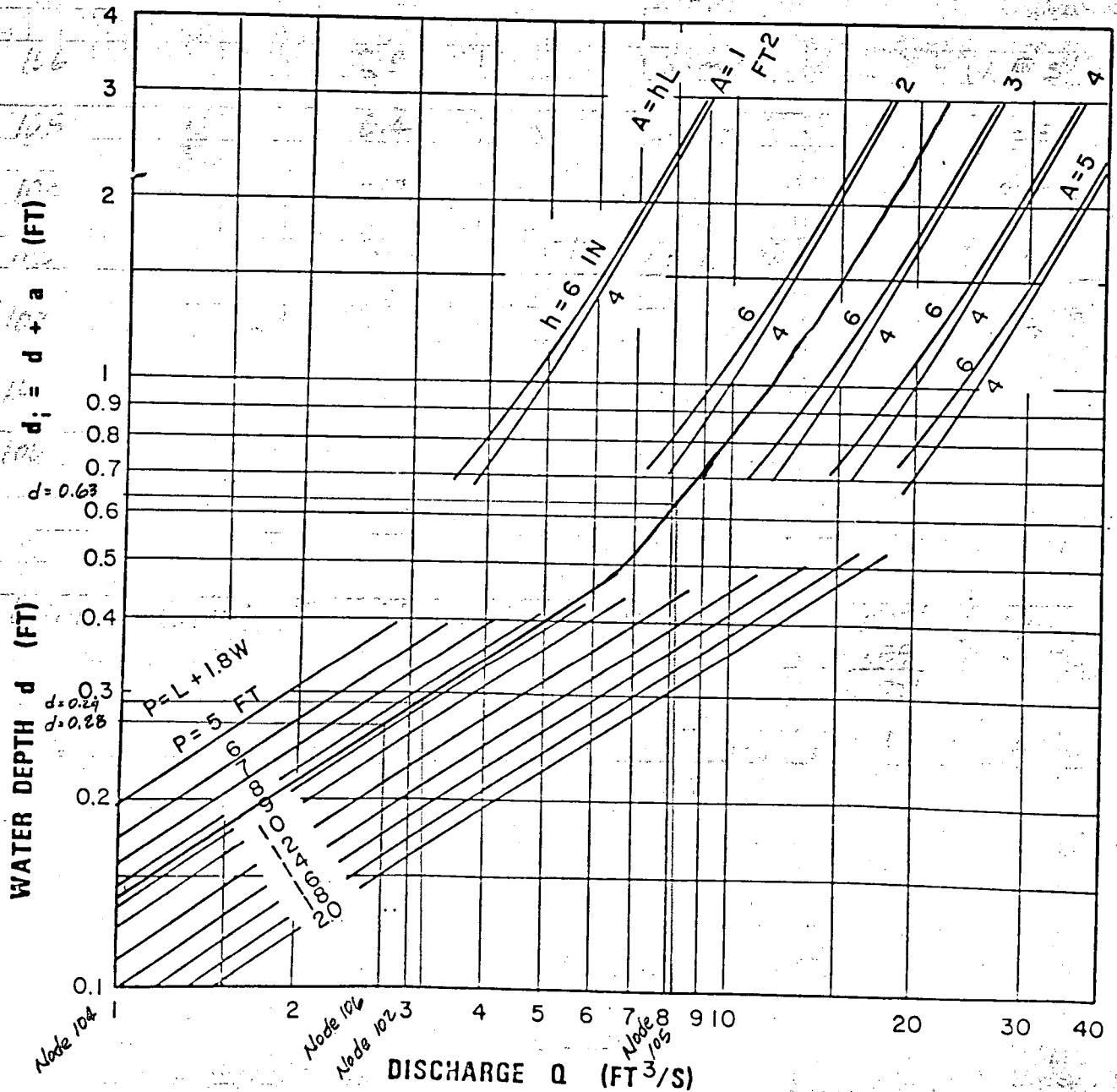


CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1984

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Project Woodbridge 3rd Add'n

Item Drainage Plan.

Check Street Flow - 2-yr.

Node	Q_2	Distribution	S	d	d_{allow}	
107		N/A (Not in street)				
106	2.8	20% in Parkridge = 0.6 cfs	0.32%	0.18'	0.55'	C
		80% in " Ct. = 2.2 cfs	1.1%	0.23'	0.3'	O
105	6.4	33% in Parkridge Ct = 2.8	@ 1.1%	0.24'	0.3'	C
		67% in Parkridge = 5.6	@ 0.32%	0.40	0.55'	O
104	0.7	50% (N) = 0.35 cfs	@ 0.32%	0.14'	0.55'	OK
		50% (S) = 0.35 cfs	@ 0.32%	0.14	0.55'	OK
102	3.1	50% (N) = 1.55 cfs	@ 0.32%	0.26'	0.3'	OK
		50% (S) = 1.55 cfs	@ 0.32%	0.26'	0.3'	OK

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Project Woodbridge 3rd Add'n

Item Drainage Plan

Check Street Flow

$Q_{street} = Q_{100} - Q_2 = 62.4 \text{ cfs} - 27.8 \text{ cfs}$ (from comp. readouts)

$= 34.6 \text{ cfs}$

Q_{allow} (@ 0.32%) $= 670.66 \sqrt{S}$

(See Sheet 6)

$Q_{allow} = 670.66 \sqrt{0.0032}$

$= 37.93$ OK

$z = \frac{1}{3/8"/Ft} = 32$

$n = 0.016$

$z/n = 32/0.016 = 2000$

Chart 1

EQUATION: $Q = 0.56\left(\frac{z}{n}\right) S^{\frac{1}{2}} d^{\frac{8}{3}}$

n IS ROUGHNESS COEFFICIENT IN MANNING FORMULA APPROPRIATE TO MATERIAL IN BOTTOM OF CHANNEL

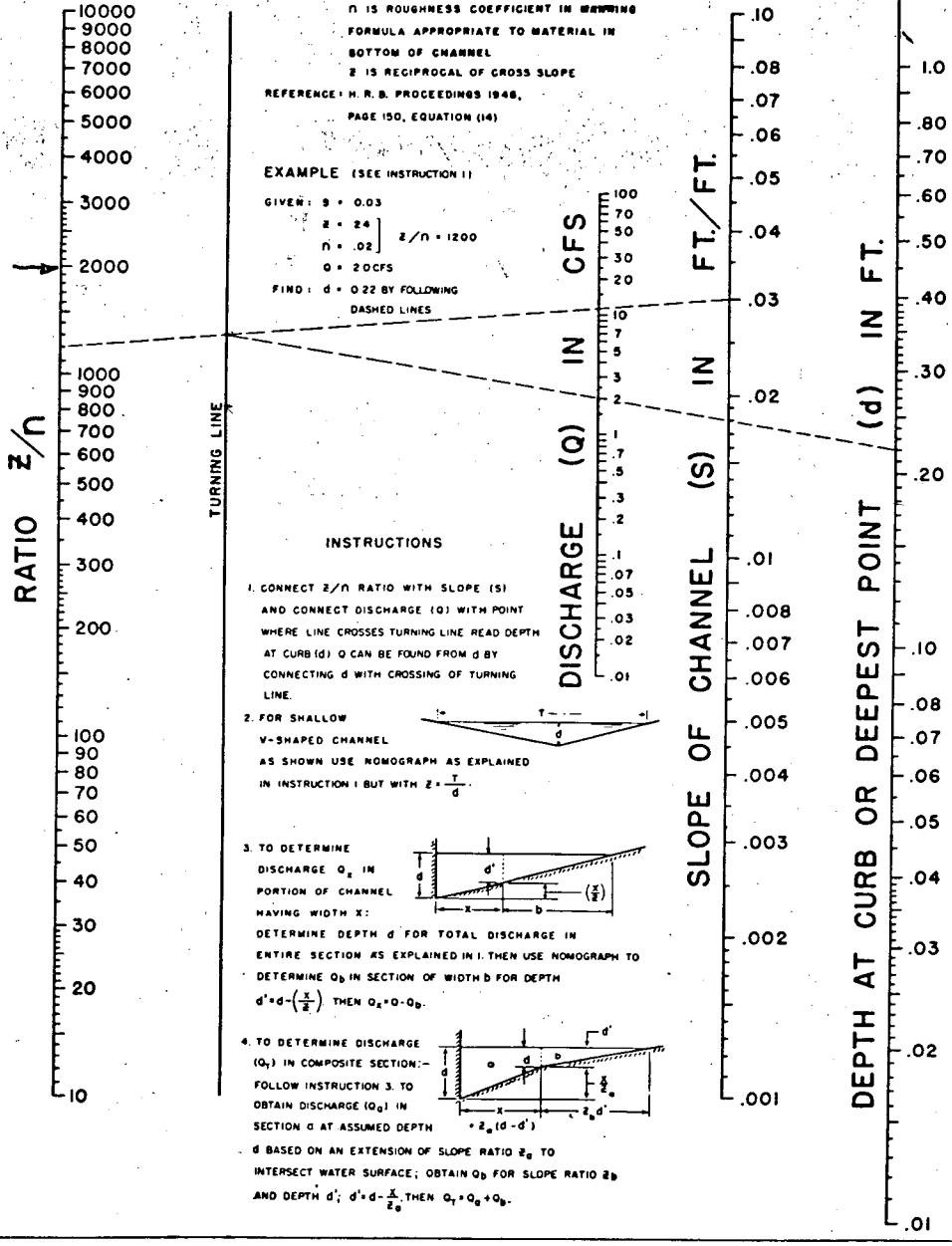
z IS RECIPROCAL OF CROSS SLOPE

REFERENCE: H. R. B. PROCEEDINGS 1948, PAGE 150, EQUATION (14)

EXAMPLE (SEE INSTRUCTION 1)

GIVEN: $S = 0.03$, $z = 24$, $n = .02$, $z/n = 1200$, $Q = 20$ CFS

FIND: $d = 0.22$ BY FOLLOWING DASHED LINES



INSTRUCTIONS

1. CONNECT z/n RATIO WITH SLOPE (S) AND CONNECT DISCHARGE (Q) WITH POINT WHERE LINE CROSSES TURNING LINE READ DEPTH AT CURB (d). Q CAN BE FOUND FROM d BY CONNECTING d WITH CROSSING OF TURNING LINE.

2. FOR SHALLOW V-SHAPED CHANNEL AS SHOWN USE NOMOGRAPH AS EXPLAINED IN INSTRUCTION 1 BUT WITH $z = \frac{T}{d}$.

3. TO DETERMINE DISCHARGE Q_x IN PORTION OF CHANNEL HAVING WIDTH X: DETERMINE DEPTH d' FOR TOTAL DISCHARGE IN ENTIRE SECTION AS EXPLAINED IN 1. THEN USE NOMOGRAPH TO DETERMINE Q_b IN SECTION OF WIDTH b FOR DEPTH $d' = d - \left(\frac{x}{z}\right)$ THEN $Q_x = Q - Q_b$.

4. TO DETERMINE DISCHARGE (Q_T) IN COMPOSITE SECTION:- FOLLOW INSTRUCTION 3. TO OBTAIN DISCHARGE (Q_a) IN SECTION a AT ASSUMED DEPTH d BASED ON AN EXTENSION OF SLOPE RATIO z_a TO INTERSECT WATER SURFACE; OBTAIN Q_b FOR SLOPE RATIO z_b AND DEPTH d'; $d' = d - \frac{x}{z_a}$ THEN $Q_T = Q_a + Q_b$.

BUREAU OF PUBLIC ROADS
REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

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Project Woodbridge 3rd Add.

Item STREET FLOW EQUATIONS

35' BK-BK STREET (½ STREET CAPACITY)

15' x 3/8"/1 = 0.46875'

℄ to ℄ = 0.47 + 0.05 = 0.52

Curb deep flow is 0.03' above crown.

T = (depth above ℄)/Sx

n = 0.016

Sx = 3/8 in/ft = 0.03125 ft/ft

B = T − 16.6' (See I Below)

I. At d = 0.52' (Crown deep)

T = 0.52/0.03125 = 16.6'

$$Q = \frac{0.56}{0.016}(0.03125)^{5/3}(16.6)^{8/3}\sqrt{S}$$

$$= 194.58\sqrt{S}$$

II At d = 0.55' (Curb deep)

T = 17.6'

B = 1.0'

$$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(17.6)^{8/3} - 1^{8/3}\right]$$

$$= 227.32\sqrt{S}$$

III. At d = 0.85' (T.C. + 0.302') (14'-6" Pkg.) (¼"/1 Sl.)

d = 0.85

T = 27.26

B = 10.66

$$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(27.26)^{8/3} - (10.66)^{8/3}\right]$$

$$= 670.66\sqrt{S}$$

IV At T.C. +0.41' (14'-6" Pkg, 3/8"/1 Sl.)

d = 0.96'

T = 30.72'

B = 14.12'

$$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(30.72)^{8/3} - (14.12)^{8/3}\right]$$

$$= 878.09\sqrt{S}$$

V At T.C. +0.52' (14'-6" Pkg, ½"/1 Sl.)

d = 1.07'

T = 34.24'

B = 17.64'

$$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(34.24)^{8/3} - (17.64)^{8/3}\right]$$

$$= 1112.64\sqrt{S}$$

VI At T.C. +0.63' (14'-6" Pkg, 5/8"/1 Sl.)

d = 1.18'

T = 37.76'

B = 21.16'

$$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(37.76)^{8/3} - (21.16)^{8/3}\right]$$

$$Q = 1369.72\sqrt{S}$$

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Project Woodbridge 3rd Add'n

Item Drainage Plan

Node 107 to Cul-De-Sac.

Q_{100} = 30.2 cfs

Q_2 = 13.6 cfs

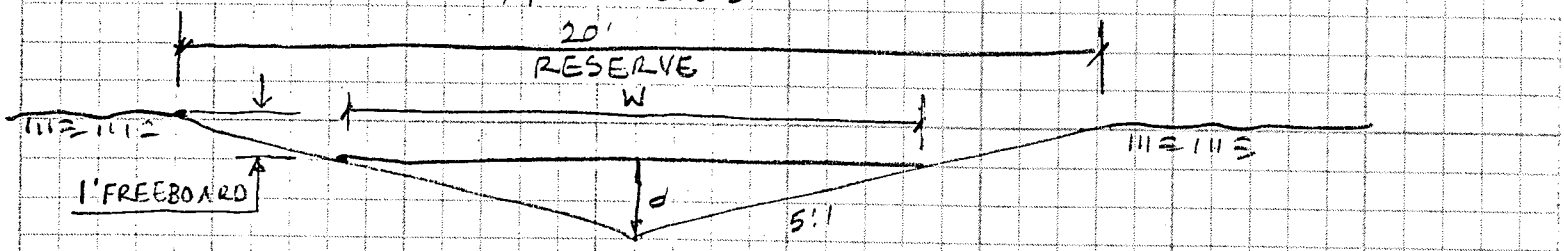
$Q_{overland} = Q_{100} - Q_2 = 30.2 - 13.6 = 16.6$ cfs

USE MANNINGS EQ'N $Q = \frac{1.486}{n} AR^{2/3} s^{1/2}$ where $Q = 16.6$, $n = 0.030$, $s = 0.01$ ft/ft

$$16.6 = \frac{1.486}{0.035} (AR^{2/3})(0.01)^{1/2}$$

$$16.6 = 49.53 (AR^{2/3}) 0.10$$

$$AR^{2/3} = 3.35$$



d	A	P	R	$R^{2/3}$	$AR^{2/3}$
1.0	5.0	10.20	0.49	0.62	3.10
1.1	6.05	11.22	0.54	0.66	4.00

USE $d = 1.0'$, $W = 10'$

$V = Q/A = 16.6/5.0 = 3.3$ fps OK.

```
110 t,woodbridge 3rd addition
120 t,storm sewer system 200
130 i,  210      0.40      1.80      0.00      0.00      0.00     15.00    166.50
140 i,  209      0.40      3.30      0.00      0.00      0.00     15.00    166.50
150 i,  208      0.40      3.30      0.00      0.00      0.00     15.00    166.50
160 i,  204      0.40      4.70      0.00      0.00      0.00     15.00    160.00
170 i,  207      0.40      1.80      0.00      0.00      0.00     15.00    160.00
180 i,  206      0.40      1.10      0.00      0.00      0.00     15.00    160.00
190 i,  205      0.40      0.10      0.00      0.00      0.00     15.00    160.40
200 i,  203      0.40      0.80      0.00      0.00      0.00     15.00    159.80
210 i,  202      0.40      0.90      0.00      0.00      0.00     15.00    159.80
220 i,  201      0.40      2.10      0.00      0.00      0.00     15.00    159.40
230 m,  200    155.50
240 p,  210  208     70.00   15 0.013   45.00    0.00
250 p,  209  208     70.00   15 0.013   45.00    0.00
260 p,  208  206    550.00   24 0.013   45.00    0.00
270 p,  207  206     35.00   15 0.013   45.00    0.00
280 p,  206  205     43.00   30 0.013   45.00    0.00
290 p,  205  204    110.00   30 0.013   95.00    0.00
300 p,  204  202     75.00   30 0.013   10.00    0.00
310 p,  203  202     35.00   15 0.013   95.00    0.00
320 p,  202  201    340.00   36 0.013    0.00    0.00
330 p,  201  200    155.00   36 0.013   90.00    0.00
340 e
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Dat[illegible]2-2[illegible]6
Time: 13:50:51

Input File: wdbr200

woodbridge 3rd addition
storm sewer system 200

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

Node	to Node	C	Tributary Area: Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	Hydrology Summation: TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Conduit Data: Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
210	208	0.40	1.80	0.00	0.0	15.00	4.06	2.92	15.00	4.06	2.92	2.92	15"	2.38	70.00	0.49	15.49
209	208	0.40	3.30	0.00	0.0	15.00	4.06	5.36	15.00	4.06	5.36	5.36	15"	4.37	70.00	0.27	15.27
208	206	0.40	3.30	0.00	0.0	15.00	4.06	5.36	15.49	4.01	5.29	13.54	24"	4.31	550.00	2.13	17.62
207	206	0.40	1.80	0.00	0.0	15.00	4.06	2.92	15.00	4.06	2.92	2.92	15"	2.38	35.00	0.24	15.24
206	205	0.40	1.10	0.00	0.0	15.00	4.06	1.79	17.62	3.81	1.68	17.98	30"	3.66	43.00	0.20	17.81
205	204	0.40	0.10	0.00	0.0	15.00	4.06	0.16	17.81	3.80	0.15	18.13	30"	3.69	110.00	0.50	18.31
204	202	0.40	4.70	0.00	0.0	15.00	4.06	7.63	18.31	3.76	7.06	25.19	30"	5.13	75.00	0.24	18.55
203	202	0.40	0.80	0.00	0.0	15.00	4.06	1.30	15.00	4.06	1.30	1.30	15"	1.06	35.00	0.55	15.55
202	201	0.40	0.90	0.00	0.0	15.00	4.06	1.46	18.55	3.74	1.34	27.75	36"	3.93	340.00	1.44	20.00
201	200	0.40	2.10	0.00	0.0	15.00	4.06	3.41	20.00	3.63	3.05	30.80	36"	4.36	155.00	0.59	20.59

Da 12-2 86
Time: 13:50:51

Input File: wdbr200

woodbridge 3rd addition
storm sewer system 200

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
210	0.00205	0.1433	0.0000	0.0000	0.0000	0.0000	0.0000	0.1433	160.4338	166.5000	6.07
209	0.00688	0.4815	0.0000	0.0000	0.0000	0.0000	0.0000	0.4815	160.7720	166.5000	5.73
208	0.00358	1.9704	0.0000	0.0015	0.0000	0.0644	0.4542	2.4905	160.2905	166.5000	6.21
204	0.00377	0.2829	0.0000	0.0197	0.0000	0.1130	0.4092	0.8249	157.3274	160.0000	2.67
207	0.00205	0.0716	0.0000	0.0000	0.0000	0.0000	0.0000	0.0716	157.8716	160.0000	2.13
206	0.00192	0.0826	0.0000	0.0160	0.0000	0.0628	0.0337	0.1951	157.8000	160.0000	2.20
205	0.00195	0.2150	0.0000	0.0004	0.0000	0.0453	0.0168	0.2774	157.6049	160.4000	2.80
203	0.00040	0.0141	0.0000	0.0000	0.0000	0.0000	0.0000	0.0141	156.5167	159.8000	3.28
202	0.00173	0.5885	0.0000	0.0339	0.0000	0.0146	-0.0913	0.5458	156.5025	159.8000	3.30
201	0.00213	0.3305	0.0000	0.0055	0.0000	0.0000	0.1208	0.4568	155.9568	159.4000	3.44
200	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	155.5000	155.5000	0.00

Input File: wdbr200

Time: 15:26:58

woodbridge 3rd addition
storm sewer system 200

Storm Frequency = 100-Year

* * * HYDROLOGY * * *

Tributary Area									Hydrology Summation				Conduit Data				
Node	to Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
210	208	0.40	1.80	0.00	0.0	15.00	8.97	6.46	15.00	8.97	6.46	6.46	15"	5.26	70.00	0.22	15.22
209	208	0.40	3.30	0.00	0.0	15.00	8.97	11.84	15.00	8.97	11.84	11.84	15"	9.65	70.00	0.12	15.12
208	206	0.40	3.30	0.00	0.0	15.00	8.97	11.84	15.22	8.92	11.78	30.05	24"	9.57	550.00	0.96	16.18
207	206	0.40	1.80	0.00	0.0	15.00	8.97	6.46	15.00	8.97	6.46	6.46	15"	5.26	35.00	0.11	15.11
206	205	0.40	1.10	0.00	0.0	15.00	8.97	3.95	16.18	8.71	3.83	40.18	30"	8.18	43.00	0.09	16.27
205	204	0.40	0.10	0.00	0.0	15.00	8.97	0.36	16.27	8.69	0.35	40.52	30"	8.26	110.00	0.22	16.49
204	202	0.40	4.70	0.00	0.0	15.00	8.97	16.87	16.49	8.65	16.26	56.78	30"	11.57	75.00	0.11	16.60
203	202	0.40	0.80	0.00	0.0	15.00	8.97	2.87	15.00	8.97	2.87	2.87	15"	2.34	35.00	0.25	15.25
202	201	0.40	0.90	0.00	0.0	15.00	8.97	3.23	16.60	8.63	3.11	62.66	36"	8.87	340.00	0.64	17.24
201	200	0.40	2.10	0.00	0.0	15.00	8.97	7.54	17.24	8.50	7.14	69.80	36"	9.88	155.00	0.26	17.50

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Time: 15:26:58

Input File: wdbr200

woodbridge 3rd addition
storm sewer system 200

Storm Frequency = 100-Year

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
210	0.01000	0.7002	0.0000	0.0000	0.0000	0.0000	0.0000	0.7002	180.2424	166.5000	-13.74
209	0.03362	2.3534	0.0000	0.0000	0.0000	0.0000	0.0000	2.3534	181.8956	166.5000	-15.40
208	0.01765	9.7055	0.0000	0.0051	0.0000	0.3148	2.2519	12.2773	179.5422	166.5000	-13.04
204	0.01916	1.4373	0.0000	0.1019	0.0000	0.5646	2.1150	4.2188	164.8784	160.0000	-4.88
207	0.01000	0.3501	0.0000	0.0000	0.0000	0.0000	0.0000	0.3501	167.6149	160.0000	-7.61
206	0.00959	0.4125	0.0000	0.0761	0.0000	0.3092	0.2019	0.9999	167.2648	160.0000	-7.26
205	0.00976	1.0737	0.0000	0.0018	0.0000	0.2264	0.0847	1.3866	166.2650	160.4000	-5.87
203	0.00198	0.0692	0.0000	0.0000	0.0000	0.0000	0.0000	0.0692	160.7288	159.8000	-0.93
202	0.00883	3.0012	0.0000	0.1715	0.0000	0.0744	-0.4530	2.7941	160.6596	159.8000	-0.86
201	0.01095	1.6977	0.0000	0.0294	0.0000	0.0000	0.6384	2.3656	157.8656	159.4000	1.53
200	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	155.5000	155.5000	0.00

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Project Woodbridge 3rd Add'n

Item Drainage Plan

Check Inlet Sizes

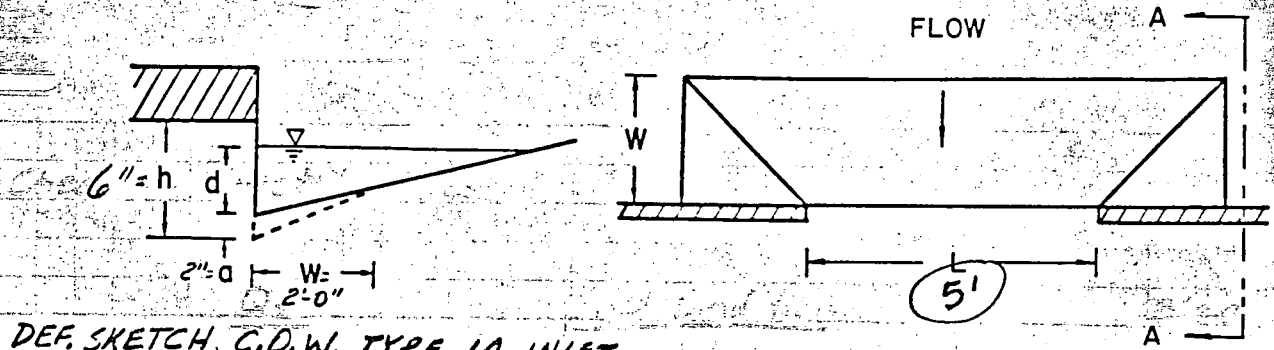
Node	Q_2	Inlet Condition	Size
210	2.9 cfs	Sump	1 - COW Type 1A L=5
209	5.4	Sump	"
208	5.4	Sump	"
207	2.9	Sump	"
206	1.8	On Grade	"
205	0.2	On Grade	"
204	7.6	Sump	"
203	1.3	Sump	"
202	1.5	Sump	"
201	3.4	Sump	"
200	-	(End Section)	-

See Page 2 for depth @ sump

(Max = 0.55' + 2" dep) = 0.72'

Inlets on grade (Nodes 206 & 205):

Since Q is small, assume 100% interception.



DEF. SKETCH, C.O.W. TYPE 1A INLET

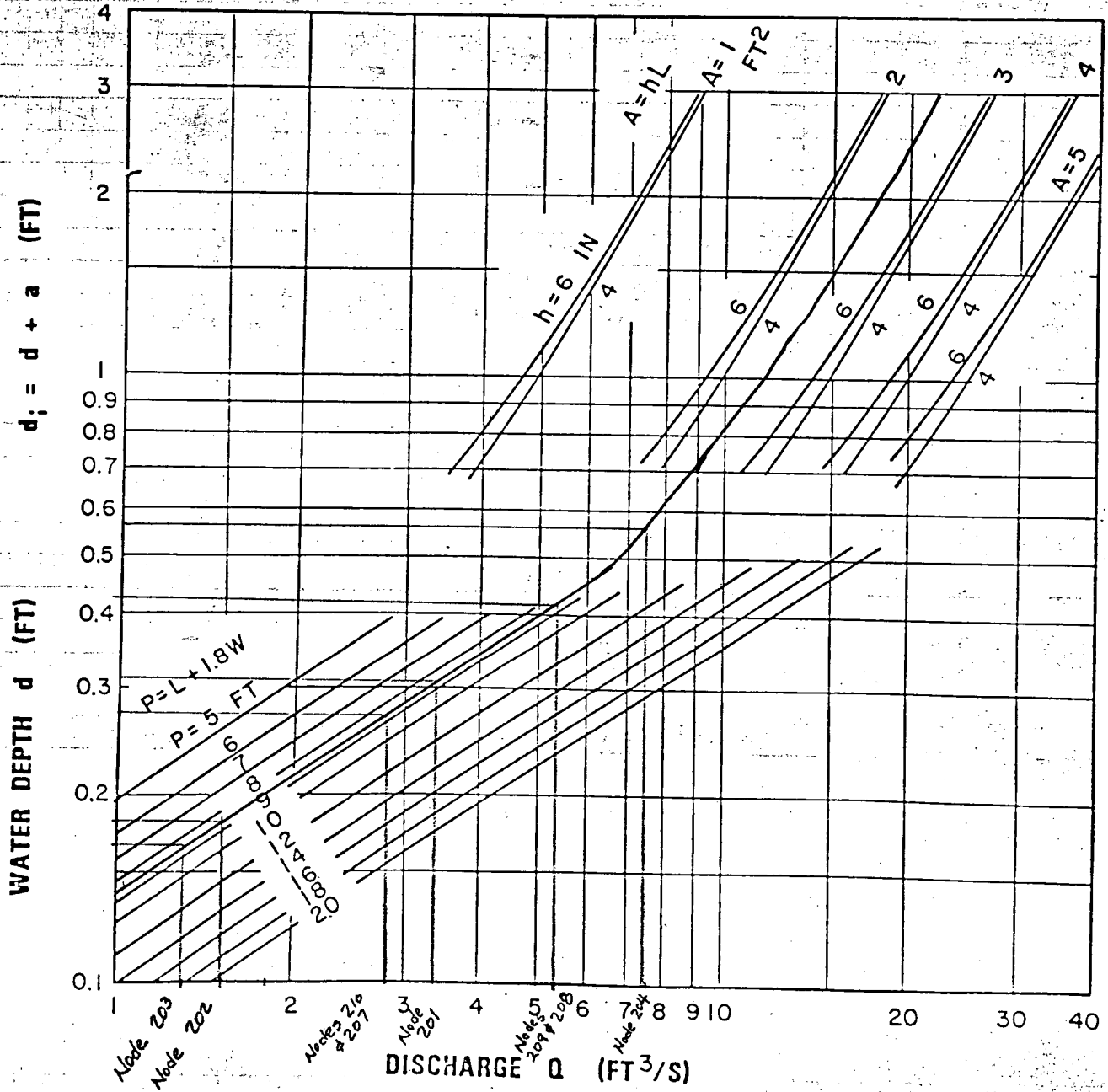


CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1984

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Project Woodbridge 3rd Add'n

Item Drainage Plan

STREET FLOW - 2YR

NODE	Q_2	Distribution	Streets	d	d_{allow}	Comment
210	2.9	25% (S) = 0.7	0.32%	0.18'	0.55'	OK
		75% (W) = 2.2	0.32%	0.28	0.3'	OK
209	5.4	50% (N) = 2.7	0.32%	0.30'	0.55'	OK
		50% (W) = 2.7	0.32%	0.30'	0.3'	OK
208	5.4	15% (S) = 0.8	0.32%	0.20'	0.55'	OK
		85% (N) = 4.6	0.32%	0.37'	0.55'	OK
207	2.9	10% (S) = 0.3	0.32%	0.13	0.55'	OK
		90% (W) = 2.6	1.20%	0.23	0.30'	OK
206	1.8	100% (W) = 1.8	1.2%	0.22	0.30'	OK
205	0.2	100% (S) = 0.2	0.32%	0.11	0.55'	OK
204	7.6	50% (S) = 3.8	0.32%	0.35'	0.55'	OK
		50% (N) = 3.8	0.32%	0.35'	0.55'	OK
203	1.3	75% (N) = 1.0	0.32%	0.22	0.55'	OK
		25% (E) = 0.3	0.32%	0.13	0.3'	OK
202	1.5	75% (S) = 1.2	0.32%	0.23	0.55'	OK
		25% (E) = 0.3	0.32%	0.13	0.3'	OK
201	3.4	50% (S) = 1.7	0.32%	0.26	0.3'	OK
		50% (N) = 1.7	0.32%	0.26	0.3'	OK

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Project Woodbridge 3rd Add'n

Item Drainage Plan

Check Street Flow 100-yr

Street Flow = $Q_{100} - Q_2$

$Q_{max} = 670.66\sqrt{S} \times 2$ (See Page 6)

$= 1341.32\sqrt{S}$

w/ S = 0.32% $Q_{max} = 75.87$

w/ S = 1.2% $Q_{max} = 146.93$

As noted on Hydrology Calcs, Q_{100} for entire system = 69 cfs (This is less than allowable max on min grade)

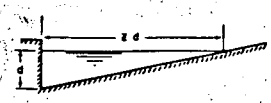
∴ All street Flow OK

$z = \frac{1}{3/8"/Ft} = 32$

$n = 0.016$

$z/n = 32/0.016 = 2000$

Chart 1



EQUATION: $Q = 0.56\left(\frac{z}{n}\right) S^{\frac{1}{2}} d^{\frac{8}{3}}$

n IS ROUGHNESS COEFFICIENT IN MANNING FORMULA APPROPRIATE TO MATERIAL IN BOTTOM OF CHANNEL

z IS RECIPROCAL OF CROSS SLOPE

REFERENCE: H. R. B. PROCEEDINGS 1946, PAGE 150, EQUATION (14)

EXAMPLE (SEE INSTRUCTION 1)

GIVEN: S = 0.03
z = 24
n = .02
z/n = 1200
Q = 20 CFS

FIND: d = 0.22 BY FOLLOWING DASHED LINES

RATIO z/n: 10000, 9000, 8000, 7000, 6000, 5000, 4000, 3000, 2000, 1000, 900, 800, 700, 600, 500, 400, 300, 200, 100, 90, 80, 70, 60, 50, 40, 30, 20, 10

TURNING LINE

DISCHARGE (Q) IN CFS: 100, 70, 50, 30, 20, 10, 7, 5, 3, 2, 1, .7, .5, .3, .2, .1, .07, .05, .03, .02, .01

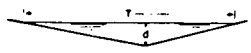
SLOPE OF CHANNEL (S) IN FT./FT.: .10, .08, .07, .06, .05, .04, .03, .02, .01, .008, .007, .006, .005, .004, .003, .002, .001

DEPTH AT CURB OR DEEPEST POINT (d) IN FT.: 2.0, 1.0, .80, .70, .60, .50, .40, .30, .20, .10, .08, .07, .06, .05, .04, .03, .02, .01

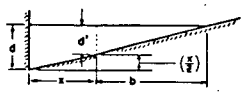
INSTRUCTIONS

1. CONNECT z/n RATIO WITH SLOPE (S) AND CONNECT DISCHARGE (Q) WITH POINT WHERE LINE CROSSES TURNING LINE READ DEPTH AT CURB (d). Q CAN BE FOUND FROM d BY CONNECTING d WITH CROSSING OF TURNING LINE.

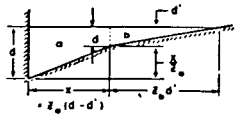
2. FOR SHALLOW V-SHAPED CHANNEL AS SHOWN USE NOMOGRAPH AS EXPLAINED IN INSTRUCTION 1 BUT WITH $z = \frac{T}{d}$.



3. TO DETERMINE DISCHARGE Q_a IN PORTION OF CHANNEL HAVING WIDTH x: DETERMINE DEPTH d FOR TOTAL DISCHARGE IN ENTIRE SECTION AS EXPLAINED IN 1. THEN USE NOMOGRAPH TO DETERMINE Q_b IN SECTION OF WIDTH b FOR DEPTH $d' = d - \left(\frac{x}{z}\right)$. THEN $Q_a = Q - Q_b$.



4. TO DETERMINE DISCHARGE (Q_T) IN COMPOSITE SECTION:— FOLLOW INSTRUCTION 3. TO OBTAIN DISCHARGE (Q_a) IN SECTION a AT ASSUMED DEPTH d BASED ON AN EXTENSION OF SLOPE RATIO z_a TO INTERSECT WATER SURFACE; OBTAIN Q_b FOR SLOPE RATIO z_b AND DEPTH d'; $d' = d - \frac{x}{z_a}$ THEN $Q_T = Q_a + Q_b$.



BUREAU OF PUBLIC ROADS
REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

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Date 5/30/85 MWB Page 6 of 6

Project Woodbridge 3rd Add.

Item STREET FLOW EQUATIONS

35' BK-BK STREET (½ STREET CAPACITY)

15' x 3/8"/1 = 0.46875'

℄ to ℄ = 0.47 + 0.05 = 0.52

Curb deep flow is 0.03' above crown.

T = (depth above ℄)/Sx

n = 0.016

Sx = 3/8 in/ft = 0.03125 ft/ft

B = T − 16.6' (See I Below)

I. At d = 0.52' (Crown deep)

T = 0.52/0.03125 = 16.6'

$Q = \frac{0.56}{0.016}(0.03125)^{5/3}(16.6)^{8/3}\sqrt{S}$

$= 194.58\sqrt{S}$

II At d = 0.55' (Curb deep)

T = 17.6'

B = 1.0'

$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(17.6)^{8/3} - 1^{8/3}\right]$

$= 227.32\sqrt{S}$

III. At d = 0.85' (T.C. + 0.302') (14'-6" Pkg.) (¼"/1 Sl.)

d = 0.85

T = 27.26

B = 10.66

$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(27.26)^{8/3} - (10.66)^{8/3}\right]$

$= 670.66\sqrt{S}$

IV At T.C +0.41' (14'-6" Pkg, 3/8"/1 Sl.)

d = 0.96'

T = 30.72'

B = 14.12'

$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(30.72)^{8/3} - (14.12)^{8/3}\right]$

$= 878.09\sqrt{S}$

V At T.C. +0.52' (14'-6" Pkg, ½"/1 Sl.)

d = 1.07'

T = 34.24'

B = 17.64'

$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(34.24)^{8/3} - (17.64)^{8/3}\right]$

$= 1112.64\sqrt{S}$

VI At T.C. +0.63' (14'-6" Pkg, 5/8"/1 Sl.)

d = 1.18'

T = 37.76'

B = 21.16'

$Q = \frac{0.56}{0.016}(0.03125)^{5/3}\sqrt{S}\left[(37.76)^{8/3} - (21.16)^{8/3}\right]$

$Q = 1369.72\sqrt{S}$

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Project Woodbridge 3rd Add'n

Item Drainage Plan

Overflow From Pine Grove St. to Cul-De-Sac

Q_{100} = Σ Nodes 208, 209, 210 = 11.8 + 11.8 + 6.5 = 30.1

Q_2 = Σ Nodes 208, 209, 210 = 5.4 + 5.4 + 2.9 = 13.7

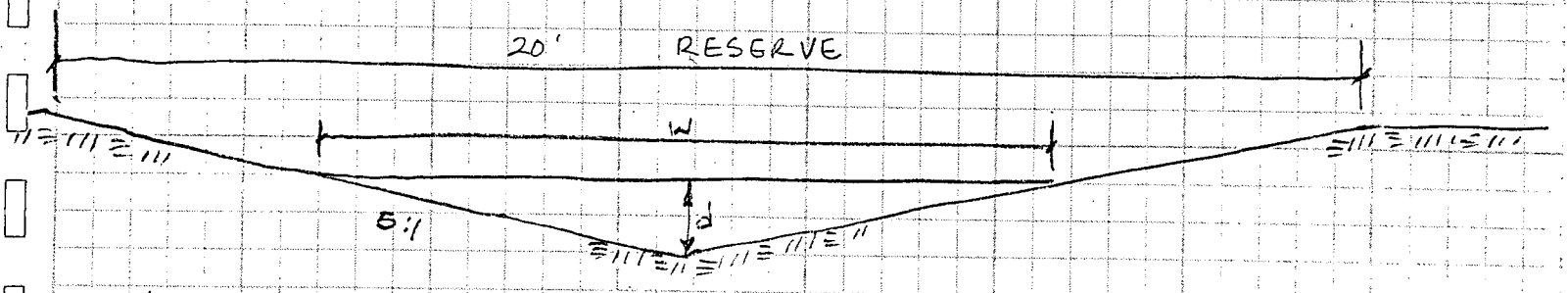
$Q_{overflow} = Q_{100} - Q_2 = 30.1 - 13.7 = 16.4$ cfs

Use Manning's Eq'n $Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$ where $Q = 16.4$ cfs, $n = 0.030$, $S = 0.01$ ft/ft

$$16.4 = \frac{1.486}{0.030} (AR^{2/3})(0.01)^{1/2}$$

$$16.4 = 49.53 (AR^{2/3}) 0.10$$

$$AR^{2/3} = 3.31$$



d	A	P	R	$R^{2/3}$	$AR^{2/3}$
1.0	5.0	10.2'	0.49	0.62	3.10
1.1	6.05	11.22	0.54	0.66	4.00

USE d = 1.0' W = 10'

V = Q/A = 16.4/5.0 = 3.3 fps