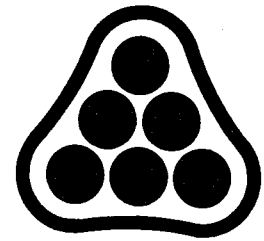


**DRAINAGE PLAN
AND
SUPPORTING CALCULATIONS**



PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

**FOR
WOODBIDGE 6TH ADDITION
TO WICHITA, SEDGWICK COUNTY, KANSAS**

**PREPARED BY
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
ENGINEERS
WICHITA, KANSAS**

JUNE 4, 1992

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Date 6/4/92 Page 1 of 5

Project Woodbridge 6th Addition

Item Drainage Plan

I, HYDROLOGY

Use Rational Method $Q = CIA$

Determine "C"

<u>Node</u>	<u>Soil Type</u>	<u>Hydrologic Group</u>	<u>Land Use</u>	<u>C₂</u>	<u>C₁₀₀</u>
109	Va	B	Res; 1/8 Ac	0.52	0.67
108	Va	B	Res; 1/8 Ac.	0.52	0.67
107	Va	B	Res; 1/8 Ac.	0.52	0.67

Determine "I"

Assume t_c all nodes = 15 minutes

$\therefore I_2 = 3.83$ $I_{100} = 7.37$

Determine "A"

<u>Node</u>	<u>Plan. Units</u>	<u>Area (SF)</u>	<u>Area (Ac)</u>
109	17.19	171,900	3.95
108	9.18	91,800	2.11
107	2.16	21,600	0.50



Date 6/4/92 Page 2 of 5
 Project Woodbridge 6th Addition
 Item Drainage Plan

Determine "Q₂"

<u>Node</u>	<u>C₂</u>	<u>I₂</u>	<u>A</u>	<u>Q₂</u>
109	0.52	3.83	3.95	7.9
108	0.52	3.83	2.11	4.2
107	0.52	3.83	0.50	1.0

TOTAL Q₂ = 13.1 cfs

Compare to Q₂ designed for Node 107
 in Woodbridge 3rd Drainage Plan (2/26/86)
 = 13.6 cfs OK

Determine "Q₁₀₀"

<u>Node</u>	<u>C₁₀₀</u>	<u>I₁₀₀</u>	<u>A</u>	<u>Q₁₀₀</u>
109	0.67	7.37	3.95	19.5
108	0.67	7.37	2.11	10.4
107	0.67	7.37	0.50	2.5

TOTAL Q₁₀₀ = 32.4 cfs

Compare to Q₁₀₀ designed for Node 107
 in Woodbridge 3rd Drainage Plan (2/26/86)
 = 30.1 cfs.



Date 6/4/92 Page 3 of 5

Project Woodbridge 6th Add

Item Drainage Plan

II. INLET SIZING

Size inlets on Q_2

<u>Node</u>	<u>Q_2</u>	<u>Q_{max} 5'</u>	<u>Use</u>
109	7.9	11.0	1 - 5' Curb Inlet
108	4.2	11.0	1 - 5' curb Inlet
107	1.0	N/A	Exist. 2'x4' Drop Inlet

III. STREET FLOW - 2 YR.

<u>Node</u>	<u>Q_2</u>	<u>Distribution</u>	<u>st. slope</u>	<u>d</u>	<u>d_{max}</u>	<u>Comment</u>
109	7.9	60% (w) = 4.7 40% (N) = 2.2	0.32% 0.40%	0.37' 0.26'	0.55' 0.55'	OK OK
108	4.2	60% (w) = 2.5 40% (N) = 1.7	0.32% 0.40%			

IV. STREET FLOW - 100-YR.

<u>Location</u>	<u>Contrib. Area</u>	<u>Q_{100}</u>	<u>Q_{pipe}</u>	<u>Q_{street}</u>	<u>street slope</u>	<u>Q_{max}</u>	<u>Comment</u>
Approaching Nodes 109 & 108 from (w)	60% 109 = 60% 108 =	11.7 6.2 <u>17.9</u>	0.0	17.9	0.32%	43.7	OK std cb WR Gr = 0.3'
Approaching Nodes 109 & 108 from (N)	40% 109 = 40% 108 =	7.8 4.2 <u>12.0</u>	0.0	12.0	0.40%	48.9	OK 11



Date 6/4/92 Page 4 of 5

Project Woodbridge 6th

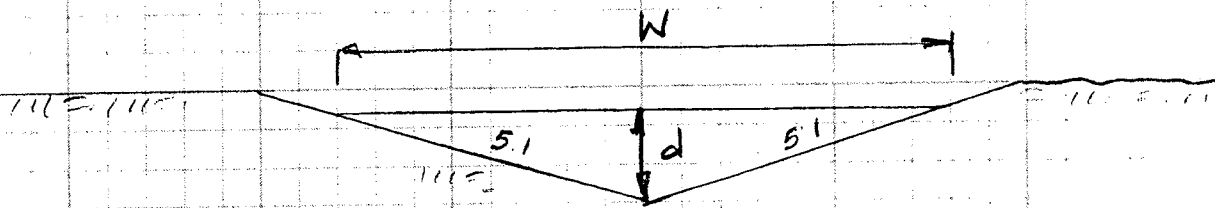
Item Drainage Plan

V OVERFLOW CHANNEL (Between Nodes 108 & 107)

$$\begin{aligned}
 Q_{100} &= 19.5 \quad (\text{Node } 109) \\
 &+ 10.4 \quad (\text{Node } 108) \\
 \hline
 &29.9 \text{ cfs}
 \end{aligned}$$

$$\begin{aligned}
 Q_2 &= 7.9 \quad (\text{Node } 109) \\
 &+ 4.2 \quad (\text{Node } 108) \\
 \hline
 &12.1
 \end{aligned}$$

$$\begin{aligned}
 Q_{\text{overflow}} &= Q_{100} - Q_2 \\
 &= 29.9 - 12.1 = 17.8 \text{ cfs}
 \end{aligned}$$



CHANNEL SECTION:

USE Manning's Eqn

$$Q = \frac{1.486}{n} AR^{2/3} s^{1/2}$$

$$17.8 = \frac{1.486}{0.03} AR^{2/3} (0.01)^{1/2}$$

$$AR^{2/3} = 3.59$$

<u>d</u>	<u>A</u>	<u>P</u>	<u>R</u>	<u>R^{2/3}</u>	<u>AR^{2/3}</u>
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: $d = 1.1'$ $V = Q/A = 17.8/6.05 = 2.94$ OK $W = 2 \times 1.1 \times 5 = 11'$ OK



Date 6/4/92 Page 5 of 5

Project Woodbridge 6th

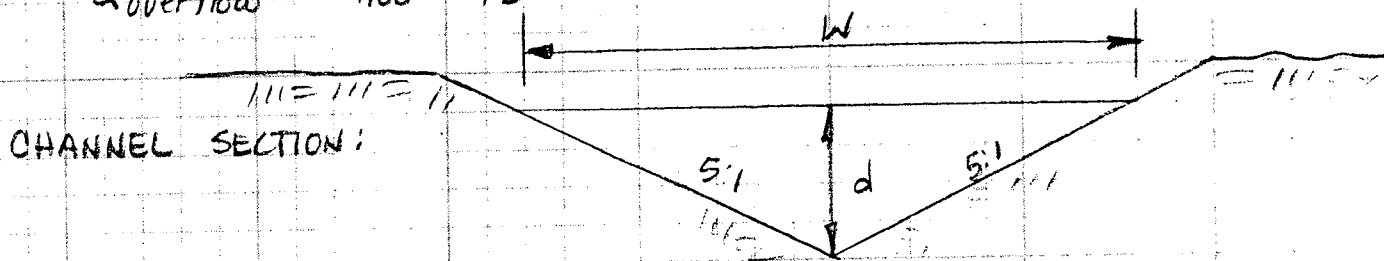
Item Drainage Plan

VI OVERFLOW CHANNEL (Between Node 107 & Inlet in Parkridge Court to East)

$$\begin{aligned}
 Q_{100} &= 19.5 \text{ (Node 109)} \\
 & 10.4 \text{ (Node 108)} \\
 & + 2.5 \text{ (Node 107)} \\
 & \underline{\hspace{1.5cm}} \\
 & 32.4 \text{ cfs}
 \end{aligned}$$

$$\begin{aligned}
 Q_2 &= 7.9 \text{ (Node 109)} \\
 & 4.2 \text{ (Node 108)} \\
 & + 1.0 \text{ (Node 107)} \\
 & \underline{\hspace{1.5cm}} \\
 & 13.1
 \end{aligned}$$

$$Q_{\text{overflow}} = Q_{100} - Q_2 = 32.4 - 13.1 = 19.3 \text{ cfs}$$



Use Manning's Eqn $Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$

$$19.3 = \frac{1.486}{0.03} AR^{2/3} (0.01)^{1/2}$$

$$AR^{2/3} = 3.89$$

(see p. 4 $d = 1.1'$ $V = 2.94 \text{ fps}$ OK $W = 11'$ OK)

1:2,295,000 FEET

390,000 FEET

WOODBRIDGE 6TH ADD.

T. 27 S.

(Joins sheet 32)

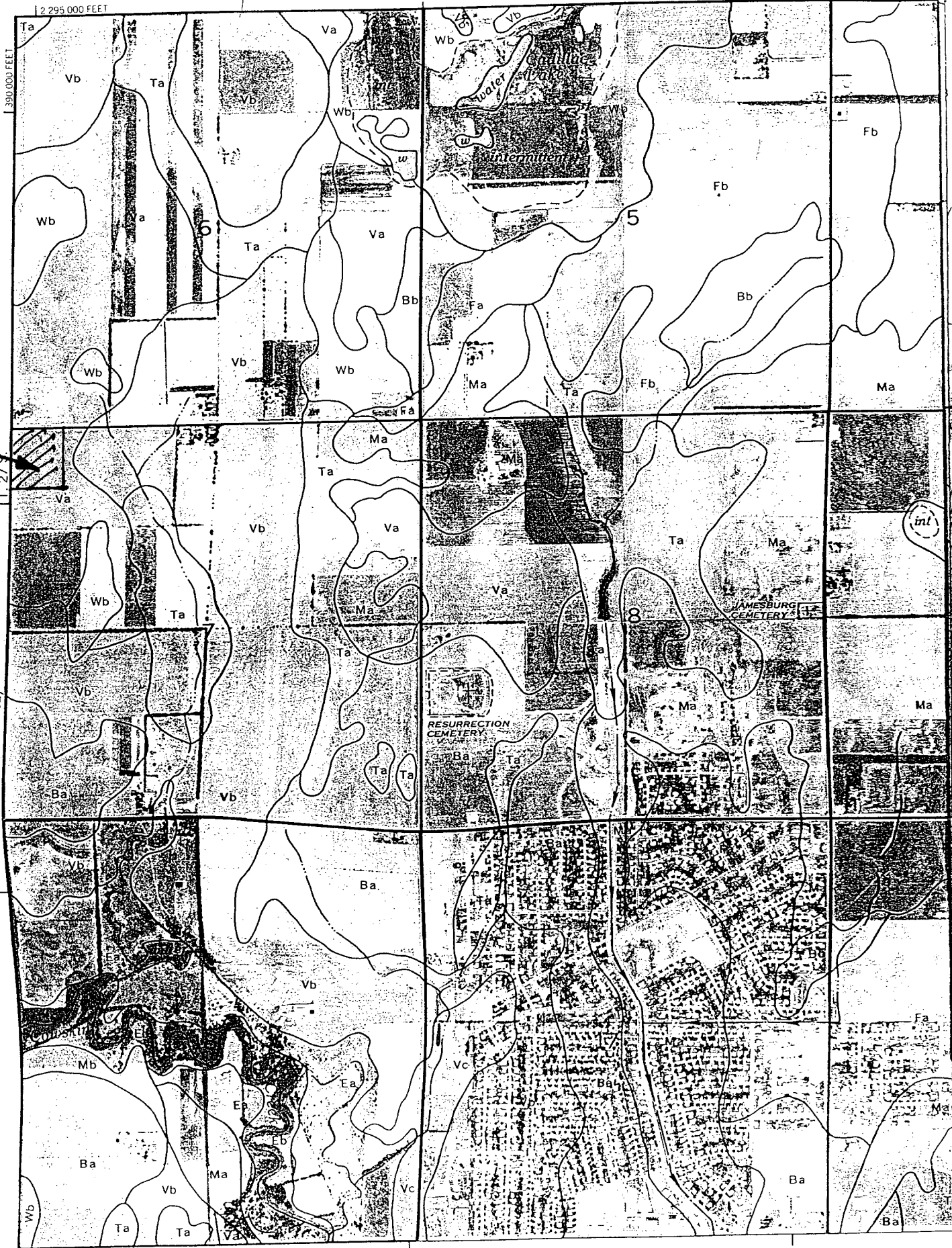


EXHIBIT NO. 1

SOIL LEGEND

<u>SYMBOL</u>	<u>HYDROLOGIC GROUP</u>	<u>NAME</u>
Aa	B	Albion-Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loams, 7 to 15 percent slopes
Ba	C -	Blanket silt loam, 0 to 1 percent slopes
Bb	C -	Blanket silt loam, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loam
Cb	B	Canadian-Waldeck fine sandy loams
Cc	D	Carwile fine sandy loam
Cd	B	Clark-Ost clay loams, 1 to 4 percent slopes
Ce	C	Cline silty clay, 3 to 6 percent slopes
Ea	B	Elandco silt loam
Eb	B	Elandco silt loam, occasionally flooded
Ec	B	Elandco silt loam, frequently flooded
Fa	B	Farnum loam, 0 to 1 percent slopes
Fb	B	Farnum loam, 1 to 3 percent slopes
Fc	B	Farnum loam, sandy substratum, 0 to 1 percent slopes
Ga	D	Goessel silty clay, 0 to 1 percent slopes
Gb	D	Goessel silty clay, 1 to 2 percent slopes
Ia	D	Irwin silty clay loam, 1 to 3 percent slopes
Ib	D	Irwin silty clay loam, 3 to 6 percent slopes
Ic	D	Irwin silty clay loam, 2 to 6 percent slopes, eroded
La	C	Lesho loam
Lb	A	Lincoln soils
Ma	B	Milan loam, 1 to 3 percent slopes
Mb	B	Milan form, 3 to 6 percent slopes
Mc	B	Milan clay loam, 2 to 6 percent slopes, eroded
Na	B	Naron fine sandy loam
Oc	D	Owens clay loam, 1 to 3 percent slopes
Od	D	Owens-Rock outcrop complex, 3 to 10 percent slopes
Pa		Pits
Pb	D	Plevna fine sandy loam
Pc	A	Pratt loamy fine sand, undulating
Pd	A	Pratt-Tivoli complex, rolling
Ra	D	Renfrow silty clay loam, 1 to 3 percent slopes
Rb	D	Renfrow silty clay loam, 3 to 6 percent slopes
Rc	D	Renfrow-Owens clay loams, 1 to 4 percent slopes
Rd	D	Rosehill silty clay, 1 to 3 percent slopes
Sa	B	Shellabarger sandy loam, 1 to 3 percent slopes
Sb	B	Shellabarger sandy loam, 3 to 6 percent slopes
Sc	B	Shellabarger sandy loam, 3 to 6 percent slopes, eroded
Ta	D -	Tabler silty clay loam
Tb	D	Tabler-Drummond complex
Ua	B	Urban land-Canadian complex
Ub	B	Urban land-Elandco complex
Uc	B	Urban land-Farnum complex, 0 to 3 percent slopes
Ud	D	Urban land-Irwin complex, 1 to 3 percent slopes
Ue	D	Urban land-Tabler complex
Va	B	Vanoss silt loam, 0 to 1 percent slopes
Vb	B	Vanoss silt loam, 1 to 3 percent slopes
Vc	B	Vanoss silt loam, 3 to 6 percent slopes
Vd	B	Vanoss silt loam, 3 to 6 percent slopes, eroded
Ve	D	Vernon sandy loam, 1 to 3 percent slopes
Vf	D	Vernon sandy loam, 3 to 6 percent slopes
Vg	C	Waldeck sandy loam

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

RECOMMENDED RUNOFF COEFFICIENTS FOR RATIONAL METHOD
AND PERCENT IMPERVIOUS FOR UNIT HYDROGRAPH METHOD

<u>Land Use or Surface Characteristics</u>	<u>Percent Impervious</u>	<u>Frequency</u>			
		<u>2</u>	<u>5</u>	<u>10</u>	<u>100</u>
1. Business:					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
2. Residential:					
<u>Single Family (Soil Group D)</u>					
1/8 Acre	50	0.57	0.61	0.66	0.79
1/4 Acre	38	0.50	0.54	0.62	0.76
1/3 Acre	30	0.46	0.50	0.59	0.73
1/2 Acre	25	0.42	0.48	0.56	0.72
3/4 Acre	22	0.42	0.46	0.55	0.71
1 Acre	20	0.41	0.45	0.54	0.71
<u>Multi-Family (Soil Group D)</u>					
Multi-Unit (detached)	60	0.62	0.66	0.72	0.82
Multi-Unit (attached)	65	0.64	0.68	0.73	0.83
Apartments	75	0.70	0.73	0.79	0.86
<u>Single Family (Soil Group C)</u>					
1/8 Acre	50	0.55	0.58	0.64	0.73
1/4 Acre	38	0.48	0.51	0.57	0.68
1/3 Acre	30	0.43	0.46	0.53	0.65
1/2 Acre	25	0.40	0.43	0.50	0.63
3/4 Acre	22	0.39	0.42	0.49	0.62
1 Acre	20	0.37	0.40	0.48	0.61
<u>Multi-Family (Soil Group C)</u>					
Multi-Unit (detached)	60	0.60	0.63	0.69	0.77
Multi-Unit (attached)	65	0.63	0.66	0.71	0.79
Apartments	75	0.68	0.72	0.77	0.83
<u>Single-Family (Soil Group B)</u>					
1/8 Acre	50	0.52	0.54	0.59	0.67
1/4 Acre	38	0.44	0.46	0.52	0.61
1/3 Acre	30	0.39	0.41	0.47	0.57
1/2 Acre	25	0.36	0.38	0.44	0.54
3/4 Acre	22	0.34	0.36	0.42	0.52
1 Acre	20	0.33	0.35	0.40	0.51
<u>Multi-Family (Soil Group B)</u>					
Multi-Unit (detached)	60	0.58	0.60	0.65	0.72
Multi-Unit (attached)	65	0.61	0.64	0.68	0.75
Apartments	75	0.67	0.70	0.74	0.80

April 15, 1986

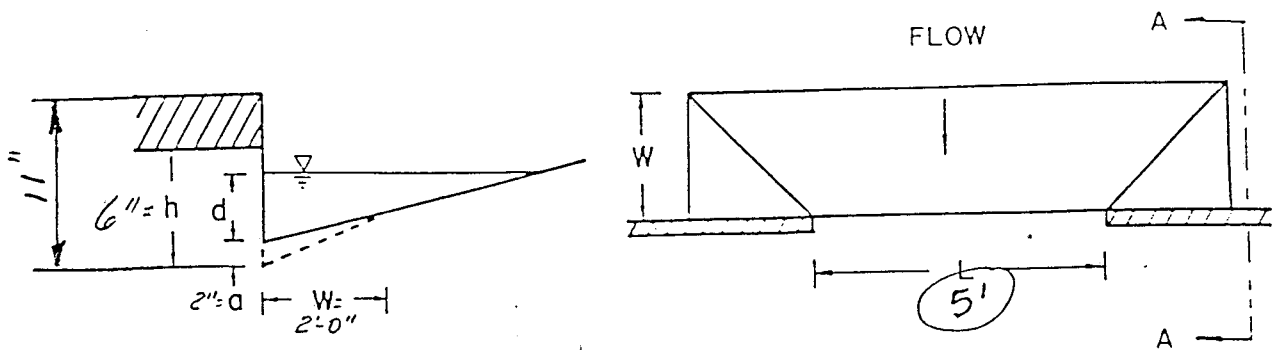
ATTACHMENT A
DRAINAGE CRITERIA MANUAL

CITY OF WICHITA, KANSAS

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40 Modified to NWS Hydro-35, 1977 During First Hour

DURATION IN MINUTES	RETURN PERIODS OF						
	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
11	3.27	4.36	5.16	5.89	6.81	7.61	8.27
12	3.18	4.21	4.99	5.71	6.60	7.38	8.02
13	3.05	4.08	4.84	5.53	6.41	7.17	7.79
14	2.96	3.95	4.69	5.37	6.23	6.97	7.57
15	2.87	3.83	4.56	5.22	6.06	6.78	7.37
16	2.78	3.72	4.43	5.08	5.90	6.60	7.18
17	2.71	3.61	4.31	4.95	5.75	6.44	7.00
18	2.63	3.51	4.20	4.83	5.61	6.29	6.84
19	2.56	3.42	4.10	4.71	5.47	6.14	6.68
20	2.50	3.33	4.00	4.60	5.35	6.00	6.53
21	2.44	3.25	3.90	4.50	5.23	5.87	6.39
22	2.38	3.17	3.81	4.40	5.12	5.75	6.26
23	2.32	3.10	3.73	4.31	5.01	5.63	6.13
24	2.27	3.03	3.65	4.22	4.91	5.52	6.01
25	2.22	2.96	3.57	4.13	4.81	5.41	5.90
26	2.20	2.90	3.50	4.05	4.72	5.31	5.79
27	2.16	2.84	3.43	3.98	4.63	5.21	5.69
28	2.14	2.78	3.37	3.90	4.55	5.12	5.59
29	2.11	2.72	3.30	3.83	4.47	5.03	5.49
30	2.08	2.67	3.24	3.76	4.39	4.94	5.40
31	2.05	2.62	3.19	3.70	4.32	4.86	5.32
32	2.02	2.57	3.10	3.63	4.25	4.79	5.22
33	1.99	2.52	3.05	3.57	4.18	4.71	5.14
34	1.96	2.48	3.01	3.51	4.11	4.63	5.07
35	1.93	2.44	2.98	3.46	4.05	4.56	5.00
36	1.91	2.39	2.93	3.41	3.99	4.50	4.93
37	1.89	2.35	2.88	3.36	3.93	4.43	4.86
38	1.87	2.32	2.84	3.31	3.87	4.37	4.79
39	1.85	2.28	2.80	3.26	3.82	4.31	4.73
40	1.83	2.24	2.76	3.22	3.76	4.25	4.66
41	1.81	2.21	2.72	3.17	3.71	4.19	4.60
42	1.79	2.18	2.68	3.13	3.66	4.13	4.54
43	1.77	2.14	2.64	3.09	3.61	4.08	4.49
44	1.75	2.11	2.61	3.05	3.57	4.03	4.43
45	1.73	2.08	2.57	3.01	3.52	3.98	4.38



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

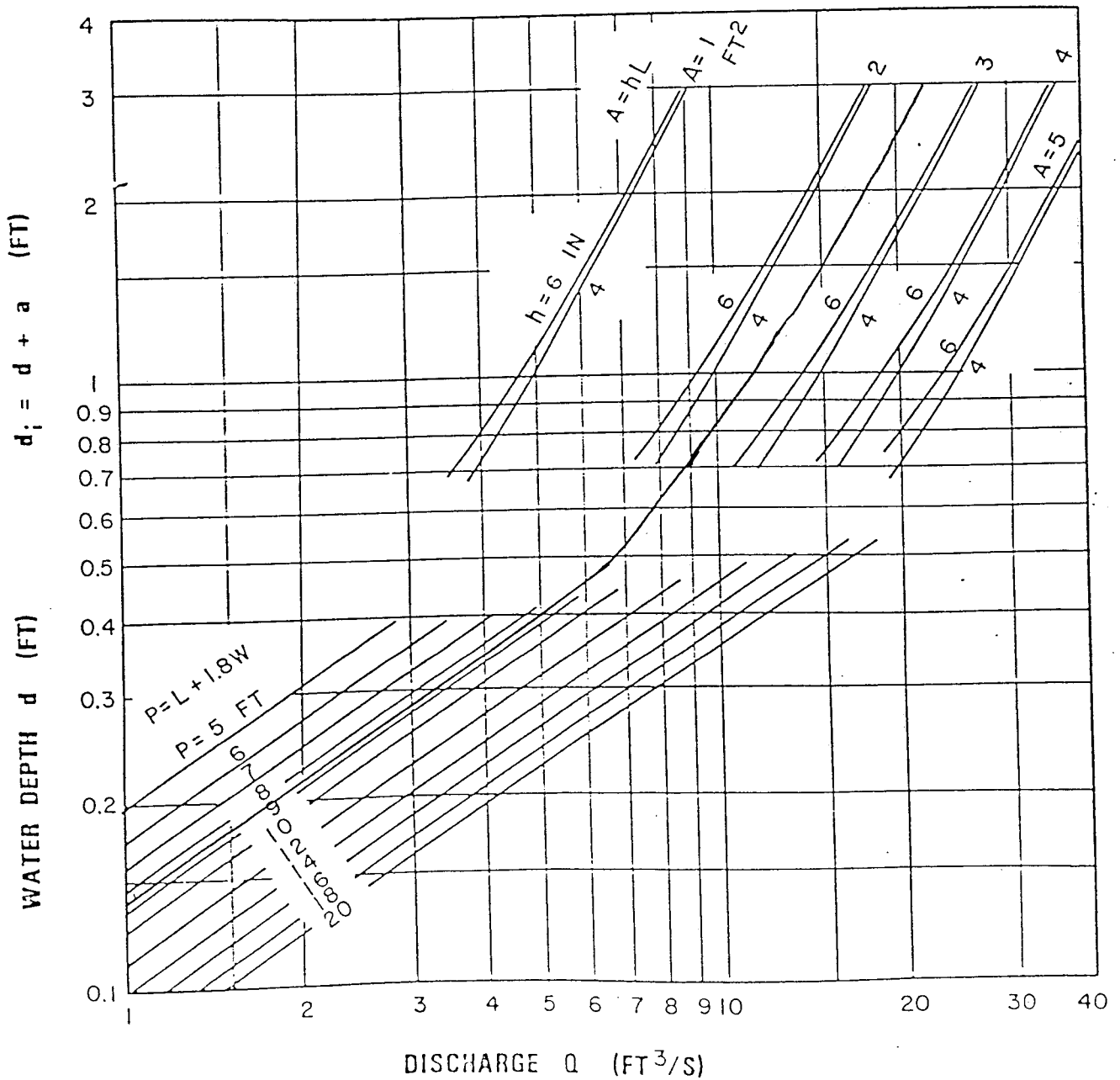


CHART 12. Depressed curb-opening inlet capacity in sump locations.

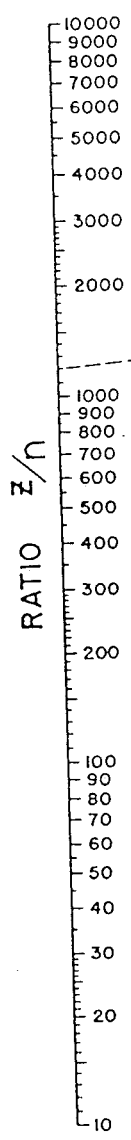
FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1973.

Chart 1



EQUATION: $Q = 0.56 \left(\frac{z}{n}\right)^{2/3} d^{5/3}$
 n IS ROUGHNESS COEFFICIENT IN MANNING'S FORMULA APPROPRIATE TO MATERIAL IN BOTTOM OF CHANNEL
 z IS RECIPROCAL OF CROSS SLOPE
 REFERENCE: H. R. B. PROCEEDINGS 1948, PAGE 150, EQUATION (14)

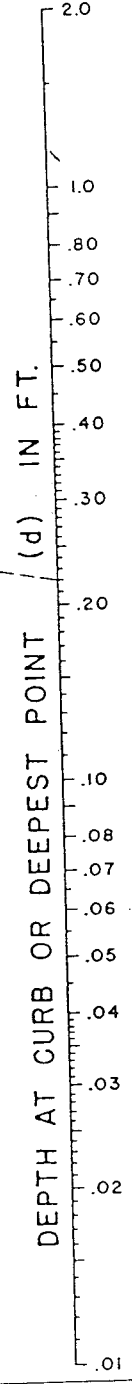
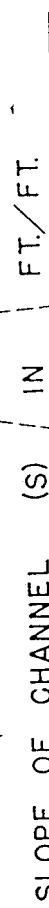
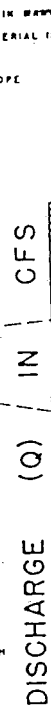
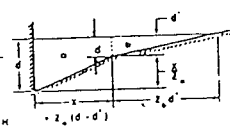
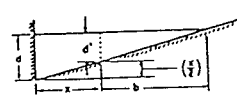
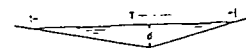
EXAMPLE (SEE INSTRUCTION 1)
 GIVEN: $z = 0.03$
 $z = 24$ } $z/n = 1200$
 $n = .02$
 $Q = 20 \text{ CFS}$
 FIND: $d = 0.22$ BY FOLLOWING DASHED LINES

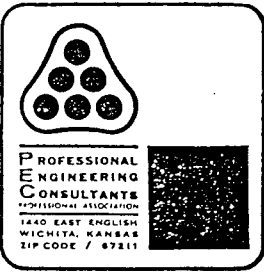


TURNING LINE

INSTRUCTIONS

1. CONNECT z/n RATIO WITH SLOPE (z) 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 $z = \frac{1}{d}$.
3. TO DETERMINE DISCHARGE Q_0 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_0 IN SECTION OF WIDTH d FOR DEPTH $d' = d \cdot \left(\frac{x}{z}\right)$ THEN $Q_0 = Q \cdot Q_0$.
4. TO DETERMINE DISCHARGE (Q_0) IN COMPOSITE SECTION: FOLLOW INSTRUCTION 3. TO OBTAIN DISCHARGE (Q_0) IN SECTION a AT ASSUMED DEPTH d BASED ON AN EXTENSION OF SLOPE RATIO z_0 TO INTERSECT WATER SURFACE; OBTAIN Q_0 FOR SLOPE RATIO z_0 AND DEPTH d' ; $d' = d \cdot \frac{z}{z_0}$ THEN $Q_0 = Q_0 + Q_0$.





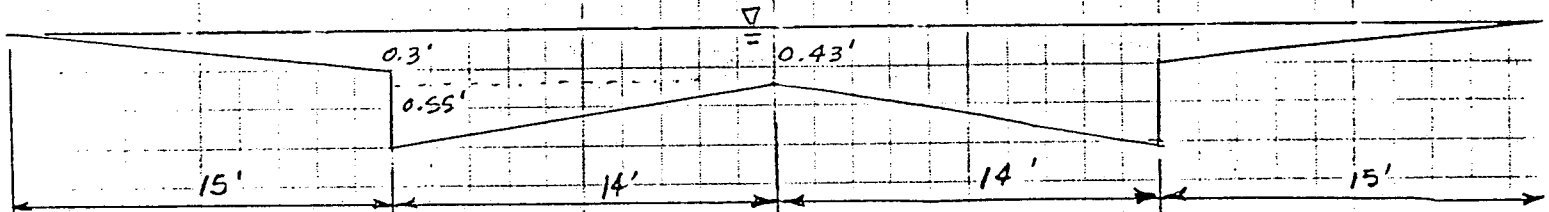
Date _____ Page _____ of _____

Project Woodbridge 6th Add.

Item Drainage Plan

Determine Capacities of Standard Curb Streets w/
Various Walk Grades for 100-year storm analysis
(58' R-O-W)

0.3' WALK GRADE



$$n = \frac{(2 \times 14.5 \times 0.03) + (2 \times 3.05 \times 0.013) + (2 \times 12 \times 0.016)}{59.1}$$

$$= \frac{(0.87) + (0.0793) + (0.384)}{59.1} = \frac{1.3333}{59.1} = 0.0226$$

$$A = (2 \times \frac{1}{2} \times 15 \times 0.3) + (28 \times 0.43) + (2 \times \frac{1}{2} \times 14 \times 0.42)$$

$$= (4.5) + (12.04) + (5.88)$$

$$= 22.42$$

$$p = 59.1$$

$$R = A/p = 22.42/59.1 = 0.379357$$

$$R^{2/3} = 0.52404$$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$Q = \frac{1.486}{0.0226} \times 22.42 \times 0.52404 \times S^{1/2}$$

$$Q = 772.5 \sqrt{S}$$