PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

DRAINAGE PLAN
AND
SUPPORTING CALCULATIONS

FOR

BARRINGTON CORNER
AN ADDITION TO WICHITA, SEDGWICK COUNTY, KANSAS

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

JUNE 17, 1988

1440 EAST ENGLISH
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Project Barrington Corner Add.

Item Drainage Plan - Hydrology

Per the drainage plan for Westwind 2nd Addition prepared by Baughman & Co., approximately 28.3 acres of land north of 21st street is drained by 2 - 49"x32" RCPHE culverts across 21st. The runoff from this area during the 100-year storm is 99 cfs @ t_c = 25 minutes. The capacity of the existing culverts limits the flow to 76 cfs. Therefore 23 cfs flows east in the north ditch of 21st St. In addition to the 76 cfs, runoff from both Aldersgate and Barrington Place Additions will enter the 21st St. ditch west of the proposed Barrington Corner Addition. Finally, the runoff from a portion of Barrington Corner itself will enter the 21st Street ditch. The combined runoff will flow east toward an existing storm sewer system located near 21st & Ridge Road.

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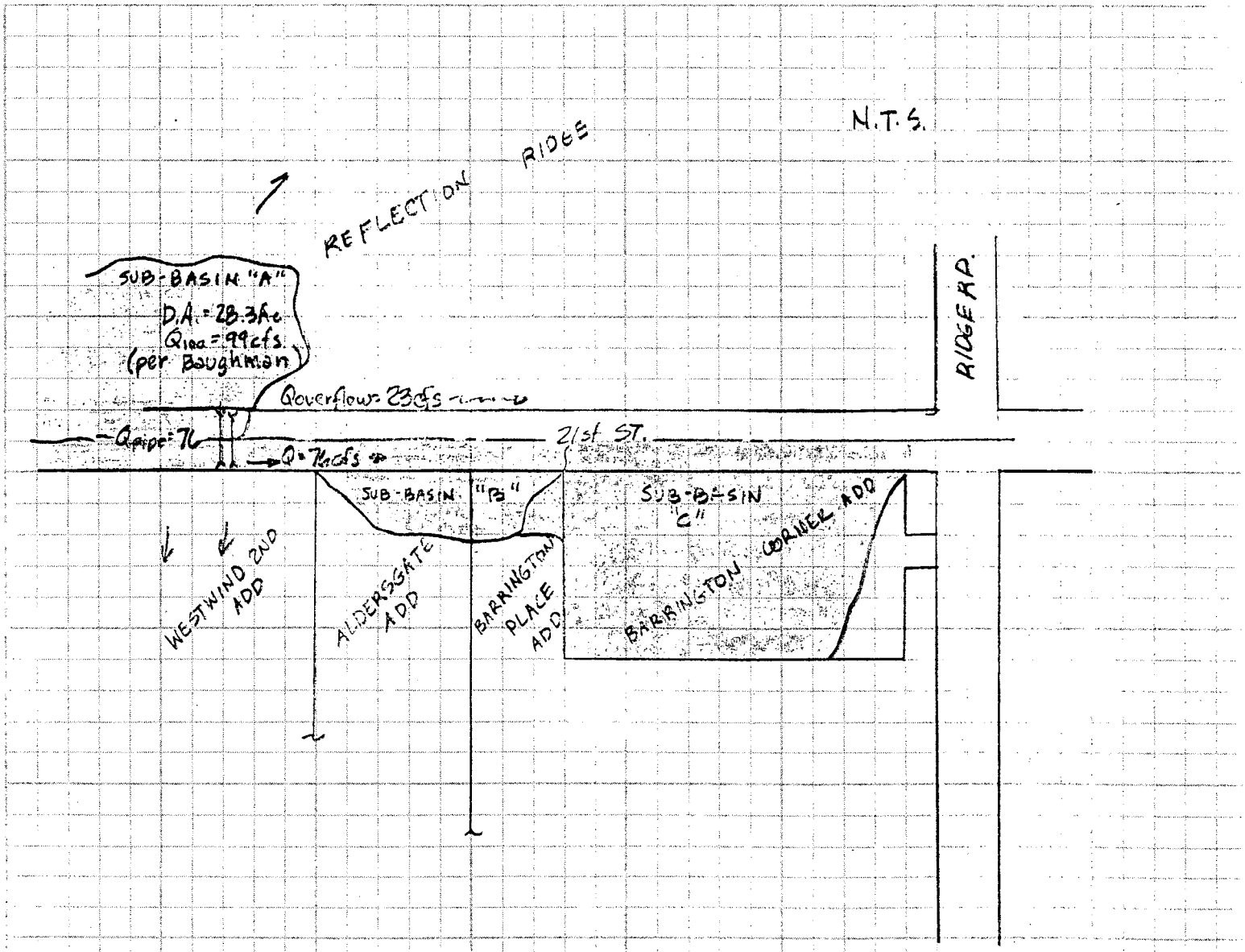
Project Barrington Corner

Item Drainage Plan - Hydrology



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Project Barrington Corner

Item Drainage Plan · Hydrology

Determine Runoff from Sub-Basin "B"

Use Rational Formula $Q = c\,I\,A$

Find "c"

soil type	Hyd. Grp	Land Use	% of Area	C_{100}	Amount
Ba	C	church (40% imp)	50	0.66	0.33
Ba	C	single fam. 1/4 Ac lot	50	0.68	0.34
			composite "c" =		0.67

Find "I"

Assume t_c = 15 min.

$I_{100} = 7.37$

Find "A"

Planimeter Units = 1570
Area per unit = 0.016 in²/unit
Area = 25.12 in² = 251,200 ft² = 5.77 Acres

Determine "Q_{100}"

$Q_{100} = C_{100}\, I_{100}\, A$

$= 0.67 \times 7.37 \times 5.77$

$= 28.5$ cfs

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Project Barrington Corner

Item Drainage Plan - Hydrology

Determine Runoff from Sub-Basin "C"

Use Rational Formula: $Q = cIA$

Determine "c"

soil type	Hyd. Group	Land Use	% of Area	C_{100}	Amount
Sa	C	Neighborhood Bus.	55	0.80	0.44
Fa	B	"	45	0.80	0.36
			100		0.80

Determine "I"

Assume t_c = 15 min.

I_{100} = 7.37

Determine "A"

Planimeter Units	Area/Unit (sq. in)	Area (sq. in)	= Area (sq ft)	= Area (ac.)
45.01	0.016	72.0	720,000	16.53

Determine Q_{100}

$Q_{100} = C_{100} I_{100} A$

$= 0.80 \times 7.37 \times 16.53$

$= 97.5$

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Project Barrington Corner

Item Drainage Plan - 21st St. Ditch

Design ditch along 21st. Street.

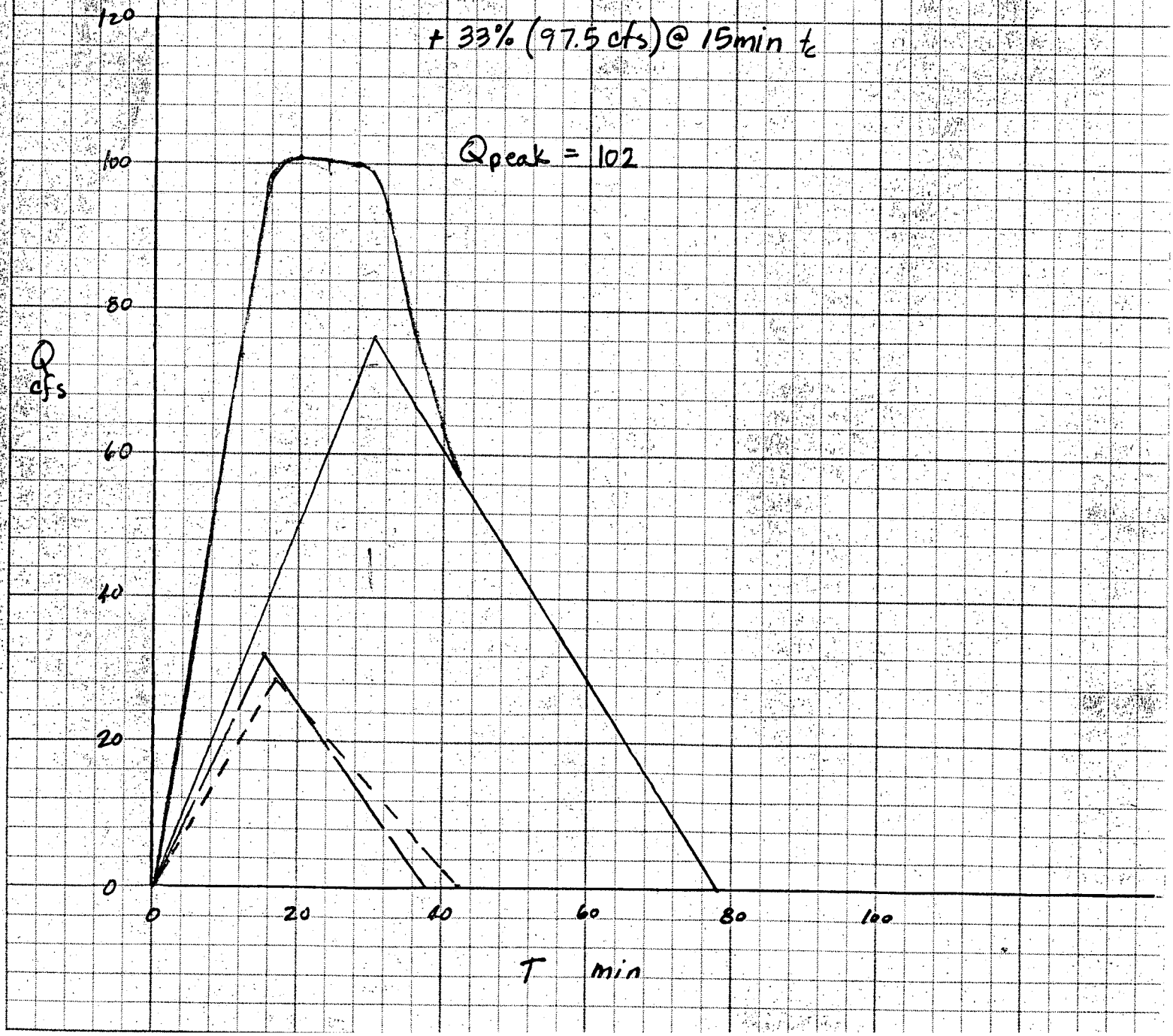
Reach #1 From W.L. Barrington Corner East 400'

Q_{100} = 76 cfs @ 25 min t_c + 6 min t_t = 31 min

+ 28.5 cfs @ 15 min t_c + 2 min t_t = 17 min

+ 33% (97.5 cfs) @ 15 min t_c

Q_{peak} = 102



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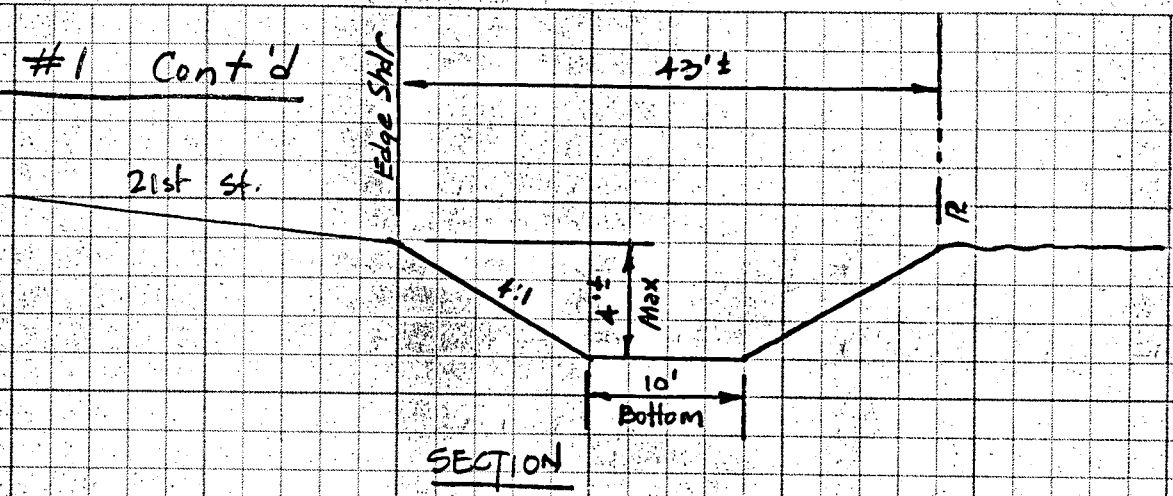
Project Barrington Corner

Item Drainage Plan - 21st St. Ditch

Reach #1 Cont'd



SECTION

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

$102 = \frac{1.486}{0.03} AR^{2/3} (0.01)^{1/2}$

$AR^{2/3} = \frac{102 \times 0.03}{1.486 \times (0.01)^{1/2}} = \frac{3.06}{0.1486} = 20.6$

d	A	P	R	$R^{2/3}$	$AR^{2/3}$	
2.0'	36.0	26.49	1.36	1.23	44.17	
1.8'	30.96	24.84	1.25	1.16	35.85	
1.6'	26.24	23.19	1.13	1.09	28.49	
1.5'	24.00	22.37	1.07	1.04	25.15	
1.4'	21.84	21.54	1.01	1.01	22.04	← USE
1.3'	19.76	20.72	0.95	0.97	19.14	

$d = 1.4$ $V = Q/A = 102/21.84 = 4.67$ OK

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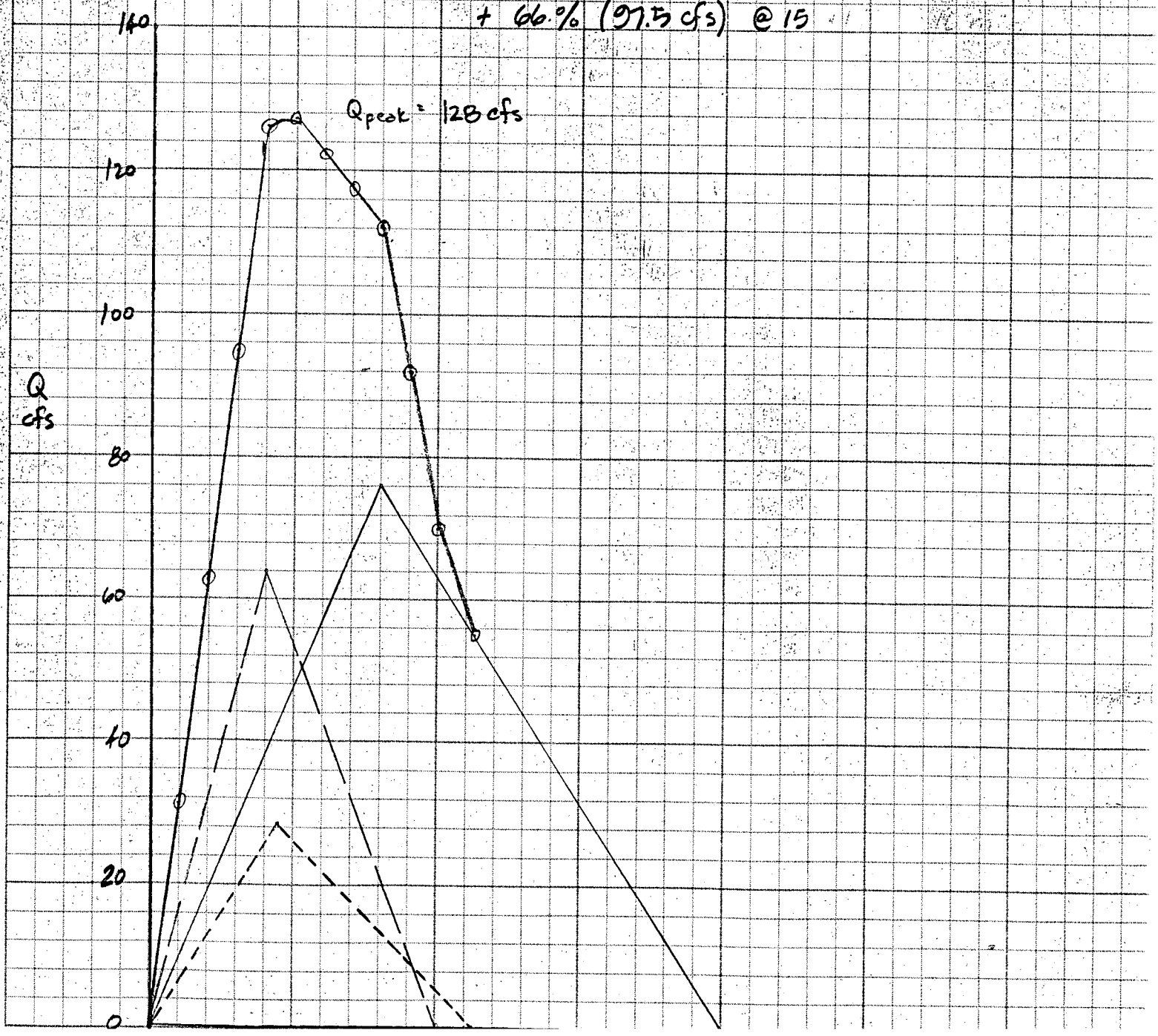
Project Barrington Corner

Item Drainage Plan - 21st St. Ditch

Reach #2

From a point 400' east of W.L. plat to 800' east of W.L. plat.

Q_{100} = 76 cfs @ 31 min + 1. t_t = 32 min
+ 28.5 cfs @ 17 + 1 = 18 min
+ 66.% (97.5 cfs) @ 15



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Project Barrington Corner

Item Drainage Plan 21st St. Ditch

Reach #2 Contd

Use same section as Reach #1

Use Manning's Equation : $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

$$128 = \frac{1.486}{0.03} A R^{2/3} (0.01)^{1/2}$$

$$A R^{2/3} = \frac{128 \times 0.03}{1.486 \times (0.01)^{1/2}}$$

$$A R^{2/3} = \frac{3.84}{0.1486} = 25.84$$

d	A	P	R	$R^{2/3}$	$AR^{2/3}$
1.5'	24.00	22.37	1.07	1.04	25.18 ← USE

d = 1.5' $V = Q/A = 128/24 = 5.3$ fps

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Project Barrington Corner

Item Drainage Plan - 21st St. Ditch

Reach #3

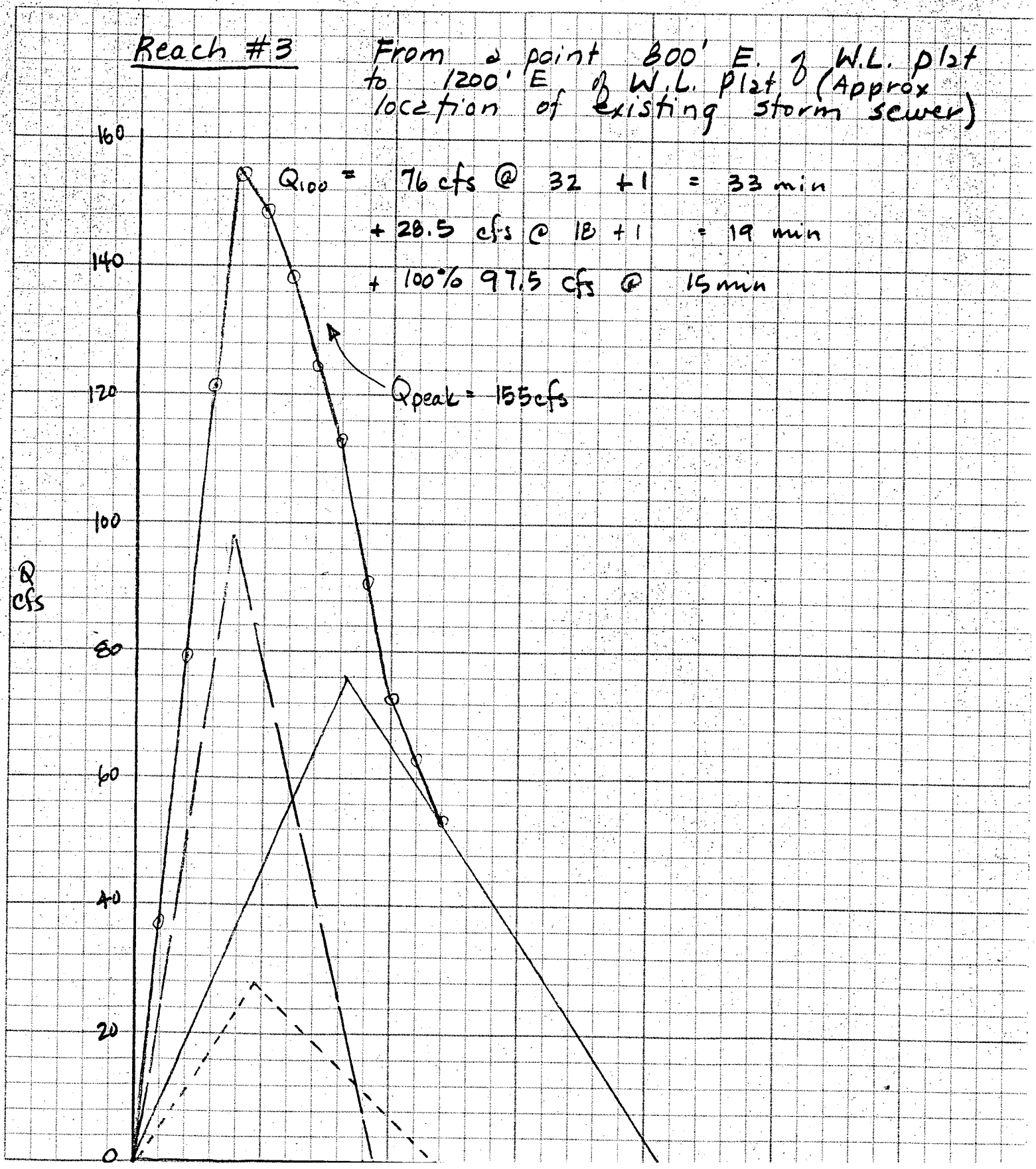
From a point 800' E. of W.L. plat to 1200' E. of W.L. plat (Approx location of existing storm sewer)

Q_{100} = 76 cfs @ 32 + 1 = 33 min

+ 28.5 cfs @ 18 + 1 = 19 min

+ 100% 97.5 cfs @ 15 min

Q_{peak} = 155 cfs



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Project Barrington Corner

Item Drainage Plan - 21st St. Ditch

Reach #3 Cont'd

Use same ditch section as Reach #1

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

$$155 = \frac{1.486}{0.03} AR^{2/3} (0.01)^{1/2}$$

$$AR^{2/3} = \frac{155 \times 0.03}{1.486 \times (0.01)^{1/2}}$$

$$AR^{2/3} = \frac{4.65}{0.1486} = 31.29$$

d	A	P	R	$R^{2/3}$	$AR^{2/3}$	
1.7'	28.56	24.02	1.19	1.12	32.06	← USE

d = 1.7' $V = Q/A = 155/28.56 = 5.42$ fps

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Project Barrington Corner

Item Drainage Plan 21st St. Ditch

SUMMARY

The 21st St. Ditch can be regraded to achieve req'd capacity.

Designer will need to review slopes & velocities & required ditch checks / linings etc.

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Project Barrington Corner

Item Drainage Plan Culverts

Design culverts for entrances into Barrington Corner for Q_{100}

Culvert #1 Located in Lot 3 between Lots 1 & 2.

Use Q_{100} developed for Ditch Reach #1

Q_{100} = 102 cfs

Inlet Control

HW allowable = 4'±
Use 3' High RCB
0° Wingwalls

HW/D = 4/3 = 1.33

From chart1: use Q/B = 20 cfs/ft

Width of box = 102/B = 20 ⇒ B = 5.1

Use 6'x3' RCB

Outlet Control

parallel wingwalls Ke = 0.7

HW = 4.0'
h_o = 1.4' ∴ H_{allow} = 3.5'
L = 90' @ 1%

From chart 8, box size req'd = 11 SF

∴ inlet control governs

USE 6'x3' RCB

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Project Barrington Corner

Item Drainage Plan Culverts

Culvert #2

Located just west of Lot 4

Use Q_{100} developed for Ditch Reach #3

$Q_{100} = 155$ cfs

Inlet Control

$HW_{allow} = 4.0'$

Use 3' High RCB

0° Wingwalls

$HW/D = 4/3 = 1.33$

From chart 1: $Q/B = 20$ cfs/ft

w/ $Q = 155$, $B = 155/20 = 7.75$

Use 8'x3' RCBC

Outlet Control

parallel wingwalls $K_e = 0.7$

$HW = 4.0$

$h_o = 1.7'$ $\therefore H_{allow} = 3.2'$

$L = 90'$ @ 1%

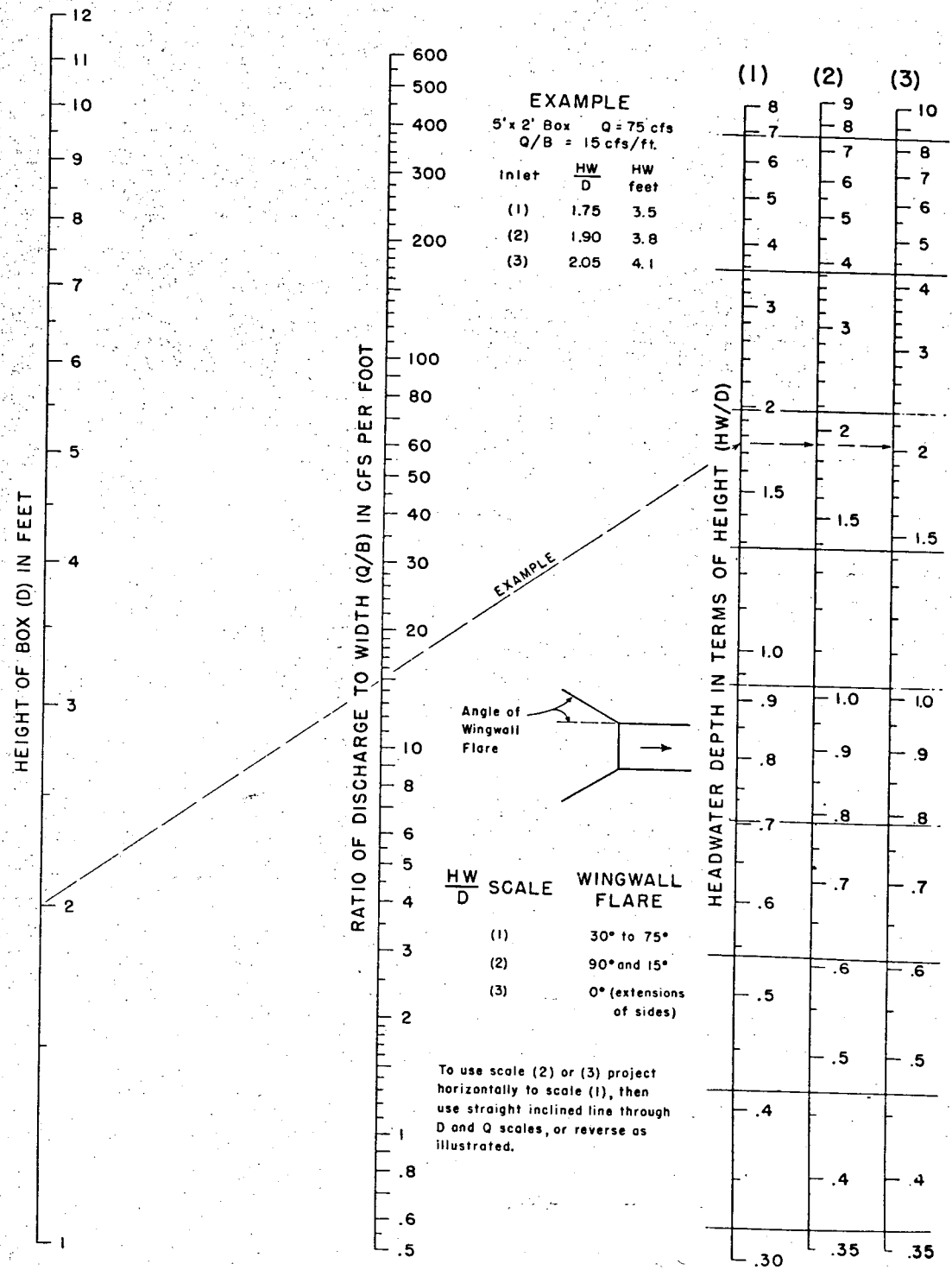
From chart 8, area req'd = 16 sf

$\therefore$ Inlet control governs

Use 8'x3' RCBC

3/6

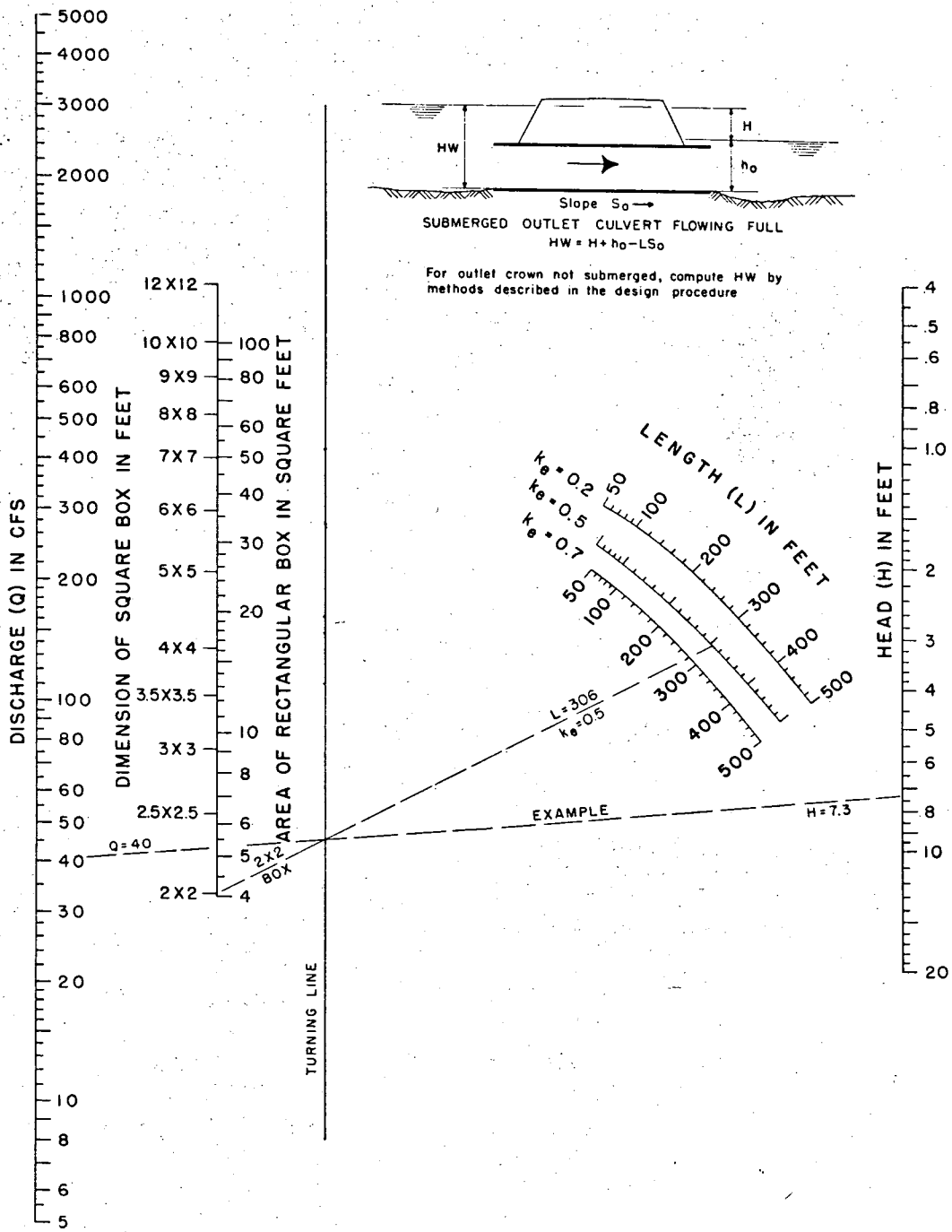
CHART I



BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

CHART 8



HEAD FOR CONCRETE BOX CULVERTS FLOWING FULL n = 0.012

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Project Barrington Corner

Item Drainage Plan Overflow

Check capacity of existing storm sewer & determine overflow.

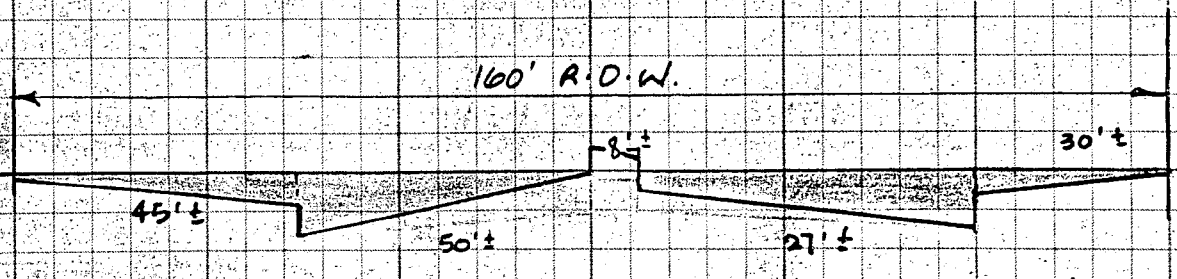
Assume HGL of existing SWS = pipe slope = ± 0.35%

∴ Capacity of 42" RCP = 60 cfs (see page 6)

Total Q_{100} approaching = 155 cfs

Q_{100} bypass = 95 cfs.

Check approx. capacity of 21st St. R.O.W



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

$n = \frac{(85' \times 0.016) + (75' \times 0.03)}{160'} = 0.023$

$A = (1/2 \times 45' \times 0.5') + (1/2 \times 50' \times 1') + (1/2 \times 30 \times 0.5) + (27 \times 0.75' \text{ avg})$

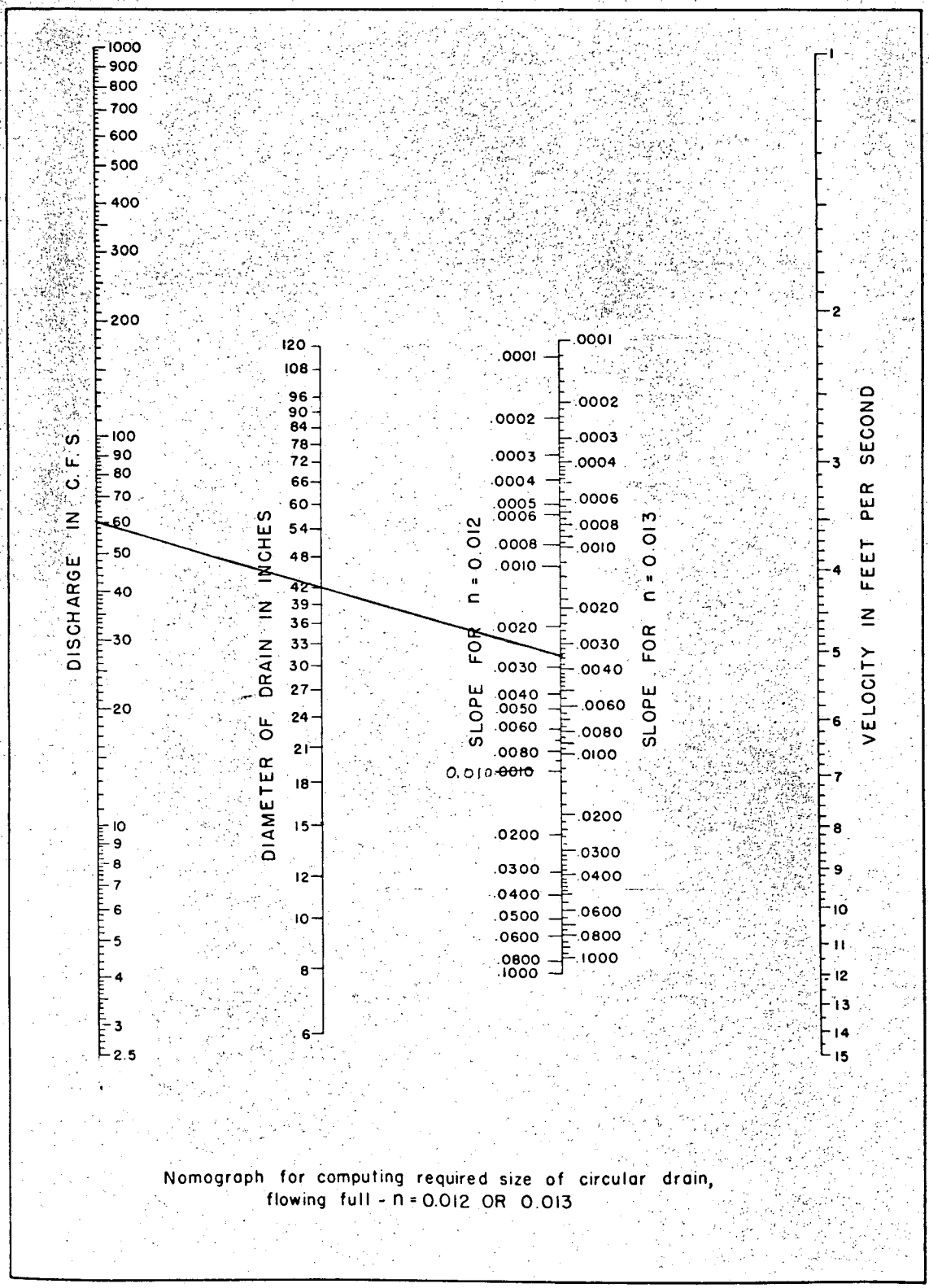
$= 64$ SF

$p = \pm 160'$

$R = A/p = 64/160 = 0.40$ $\quad R^{2/3} = 0.54$

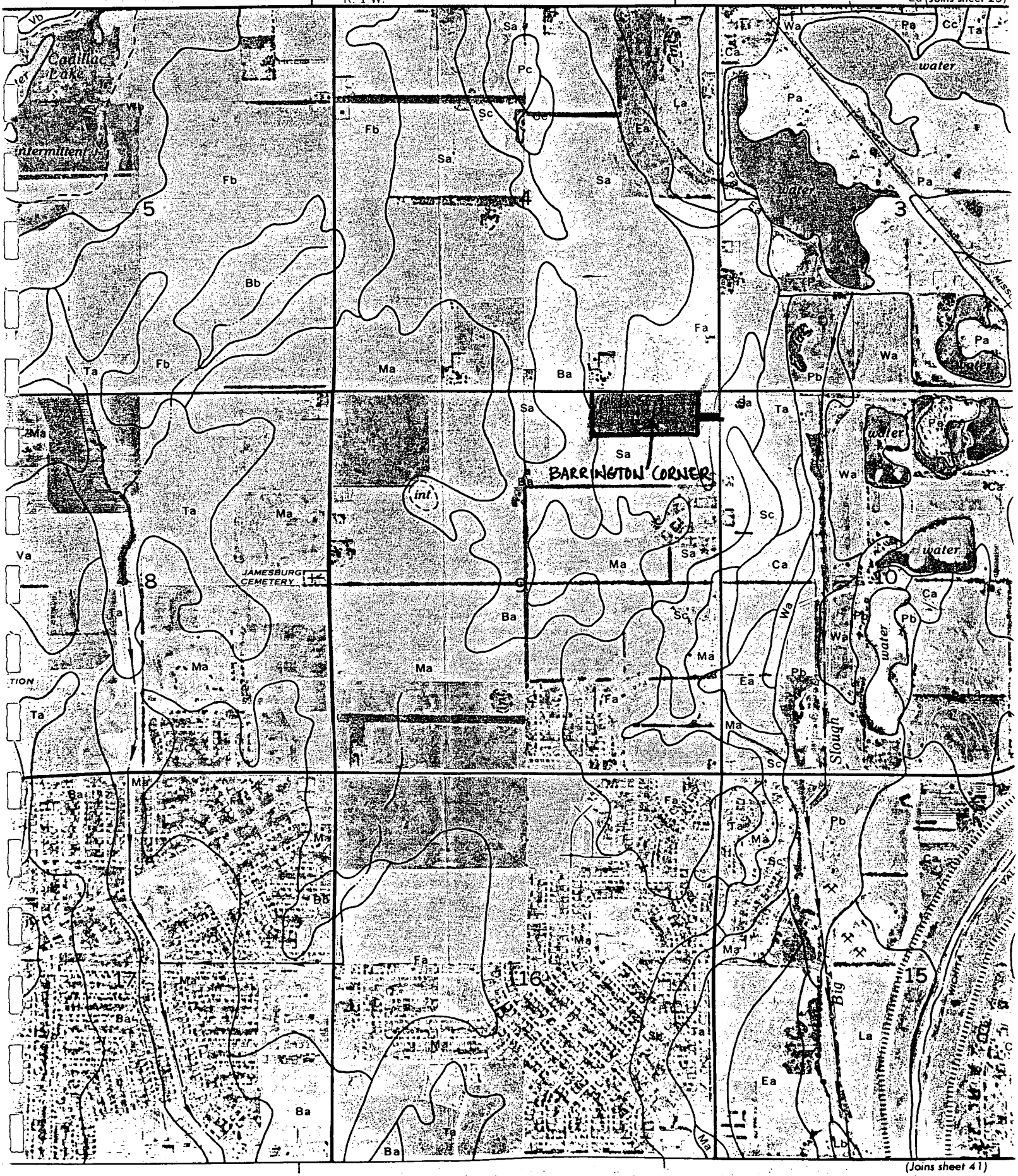
$S = 0.38\%$ $\quad S^{1/2} = 0.0616$

$Q = \frac{1.486}{0.023} \times 64 \times 0.54 \times 0.0616 = 137$ cfs



Nomograph for computing required size of circular drain, flowing full - n = 0.012 OR 0.013

SEDGWICK COUNTY, KANSAS — SHEET NUMBER 33



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

ATTACHMENT A CONTINUED
Page 2

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
46	1.70	2.05	2.54	2.97	3.48	3.93	4.33
47	1.67	2.02	2.50	2.93	3.44	3.88	4.28
48	1.66	2.00	2.47	2.90	3.39	3.84	4.23
49	1.64	1.97	2.44	2.86	3.35	3.79	4.18
50	1.61	1.95	2.41	2.83	3.32	3.75	4.13
51	1.59	1.92	2.38	2.79	3.28	3.71	4.09
52	1.56	1.89	2.35	2.76	3.24	3.67	4.05
53	1.54	1.86	2.33	2.73	3.20	3.63	4.00
54	1.52	1.84	2.30	2.70	3.17	3.59	3.96
55	1.50	1.81	2.27	2.67	3.14	3.55	3.92
56	1.47	1.79	2.25	2.64	3.10	3.51	3.88
57	1.45	1.76	2.22	2.61	3.07	3.48	3.84
58	1.43	1.74	2.20	2.59	3.04	3.44	3.81
59	1.42	1.72	2.18	2.56	3.01	3.41	3.77
60	1.40	1.69	2.15	2.53	2.98	3.37	3.73
61	1.38	1.67	2.13	2.51	2.95	3.34	3.70
62	1.36	1.65	2.11	2.48	2.92	3.31	3.67
63	1.34	1.63	2.09	2.46	2.89	3.28	3.63
64	1.33	1.61	2.07	2.44	2.86	3.25	3.60
65	1.31	1.59	2.05	2.41	2.84	3.22	3.57
66	1.30	1.57	2.03	2.39	2.81	3.19	3.54
67	1.28	1.56	2.01	2.37	2.79	3.16	3.51
68	1.26	1.54	1.99	2.35	2.76	3.13	3.48
69	1.25	1.52	1.97	2.33	2.74	3.10	3.45
70	1.24	1.50	1.95	2.31	2.71	3.08	3.42
71	1.22	1.49	1.93	2.28	2.69	3.05	3.39
72	1.21	1.47	1.92	2.26	2.67	3.02	3.36
73	1.20	1.46	1.90	2.25	2.64	3.00	3.34
74	1.18	1.44	1.88	2.23	2.63	2.98	3.31
75	1.17	1.43	1.86	2.21	2.61	2.95	3.29
76	1.16	1.41	1.85	2.19	2.58	2.93	3.26
77	1.15	1.40	1.83	2.17	2.55	2.90	3.24
78	1.13	1.38	1.82	2.15	2.53	2.88	3.22
79	1.12	1.37	1.80	2.14	2.50	2.86	3.19
80	1.11	1.36	1.79	2.12	2.48	2.84	3.16
81	1.10	1.34	1.77	2.10	2.46	2.82	3.13
82	1.09	1.33	1.76	2.08	2.43	2.79	3.10
83	1.08	1.32	1.74	2.06	2.41	2.76	3.07
84	1.07	1.31	1.73	2.04	2.39	2.74	3.04
85	1.06	1.30	1.72	2.02	2.37	2.71	3.01
86	1.05	1.28	1.70	2.00	2.34	2.69	2.99
87	1.04	1.27	1.69	1.99	2.32	2.66	2.96
88	1.03	1.26	1.68	1.97	2.30	2.64	2.93
89	1.02	1.25	1.68	1.95	2.28	2.62	2.91
90	1.01	1.24	1.66	1.93	2.26	2.59	2.88

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
91	1.00	1.23	1.65	1.92	2.24	2.57	2.86
92	1.00	1.22	1.63	1.90	2.22	2.55	2.83
93	0.99	1.21	1.62	1.89	2.20	2.53	2.81
94	0.98	1.20	1.61	1.87	2.19	2.51	2.79
95	0.97	1.19	1.59	1.85	2.17	2.49	2.76
96	0.96	1.18	1.58	1.84	2.15	2.46	2.74
97	0.96	1.17	1.57	1.82	2.13	2.44	2.72
98	0.95	1.16	1.56	1.81	2.12	2.42	2.70
99	0.94	1.15	1.54	1.80	2.10	2.41	2.67
100	0.93	1.14	1.53	1.78	2.08	2.39	2.65
101	0.93	1.13	1.52	1.77	2.07	2.39	2.65
102	0.92	1.13	1.51	1.75	2.05	2.35	2.61
103	0.91	1.12	1.50	1.74	2.04	2.33	2.59
104	0.90	1.11	1.49	1.73	2.02	2.31	2.57
105	0.90	1.10	1.47	1.72	2.01	2.30	2.55
106	0.89	1.09	1.46	1.70	1.99	2.28	2.54
107	0.88	1.09	1.45	1.69	1.98	2.26	2.52
108	0.88	1.08	1.44	1.68	1.96	2.25	2.50
109	0.87	1.07	1.43	1.67	1.95	2.23	2.48
110	0.87	1.06	1.42	1.65	1.93	2.21	2.46
111	0.86	1.06	1.41	1.64	1.92	2.20	2.45
112	0.85	1.05	1.40	1.63	1.91	2.18	2.43
113	0.85	1.04	1.39	1.62	1.89	2.17	2.41
114	0.84	1.03	1.38	1.61	1.88	2.15	2.40
115	0.84	1.03	1.37	1.60	1.87	2.14	2.38
116	0.83	1.02	1.36	1.59	1.86	2.12	2.36
117	0.82	1.01	1.36	1.58	1.84	2.11	2.35
118	0.82	1.01	1.35	1.57	1.83	2.09	2.33
119	0.81	1.00	1.34	1.56	1.82	2.08	2.32
120	0.81	0.99	1.33	1.55	1.81	2.07	2.30

DURATION IN HOURS	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
2	0.81	0.99	1.33	1.55	1.81	2.07	2.30
3	0.59	0.72	0.97	1.13	1.32	1.51	1.68
4	0.47	0.58	0.78	0.91	1.06	1.21	1.35
5	0.40	0.49	0.66	0.77	0.89	1.02	1.14
6	0.35	0.42	0.57	0.67	0.78	0.89	0.99
8	0.28	0.34	0.46	0.53	0.62	0.71	0.79
10	0.23	0.29	0.39	0.45	0.52	0.60	0.67
12	0.20	0.25	0.33	0.39	0.45	0.52	0.58
18	0.15	0.18	0.24	0.28	0.33	0.38	0.42
24	0.12	0.15	0.20	0.23	0.27	0.31	0.34

(3 pages)

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

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

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
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:					
Single Family (Soil Group D)					
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
Multi-Family (Soil Group D)					
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
Single Family (Soil Group C)					
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
Multi-Family (Soil Group C)					
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
Single-Family (Soil Group B)					
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
Multi-Family (Soil Group B)					
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

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Single Family (Soil Group A)					
1/8 Acre	50	0.47	0.50	0.54	0.60
1/4 Acre	38	0.39	0.41	0.45	0.52
1/3 Acre	30	0.33	0.35	0.39	0.47
1/2 Acre	25	0.30	0.31	0.35	0.44
3/4 Acre	22	0.28	0.29	0.33	0.42
1 Acre	20	0.26	0.28	0.32	0.40
Multi-Family (Soil Group A)					
Multi-Unit (detached)	60	0.55	0.57	0.61	0.67
Multi-Unit (attached)	65	0.58	0.60	0.64	0.70
Apartments	75	0.65	0.68	0.72	0.77
3. Industrial:					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
4. Playgrounds:	15	0.33	0.35	0.42	0.55
5. Schools:	40	0.49	0.51	0.56	0.66
6. Railroad Yard Areas:	30	0.43	0.45	0.50	0.62
7. Undeveloped Urban Areas:					
Offsite Flow Analysis (when land use not defined)	45	0.52	0.54	0.59	0.68
8. Streets:					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
9. Drive, Parking Lots and Walks:	96	0.87	0.87	0.88	0.89
10. Roofs:	90	0.80	0.85	0.90	0.93
11. Urban Lawn Areas (See Note No. 1 below):					
Soil Group A					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
Soil Group B					
Slope less than 1%	00	0.16	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
Soil Group C					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%	00	0.28	0.31	0.39	0.55

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Soil Group D					
Slope less than 1%	00	0.28	0.33	0.43	0.63
Slope 1% to 4%	00	0.30	0.35	0.45	0.65
Slope more than 4%	00	0.32	0.37	0.47	0.67

Note No. 1: Coefficients shown in the above table are for pervious open space areas with thick turf which includes pervious areas in parks and cemeteries. Coefficients shown above must be increased 0.02 for use with agricultural pasture areas. Coefficients shown above must be reduced by 0.04 for use with agricultural cultivated areas. Group A soils are well-drained, coarse textured sands with high infiltration rates. Group B soils are moderately well-drained, moderately coarse textured soils with moderate infiltration rates. Group C soils are moderately poor-drained, moderately fine textured soils with slow infiltration rates. Group D soils are poor-drained, fine textured soils with very slow infiltration rates.

GENERAL NOTE: These Rational Formula Coefficients may not be valid for basins 320 acres or larger.

ATTACHMENT E

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

AVERAGE OVERLAND FLOW VELOCITY FOR USE WITH URBANIZED AREAS

Surface Type	VELOCITY IN FEET/SECOND FOR SLOPES IN PERCENT SHOWN																			
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	20.0
Forest with Heavy Ground Litter or Meadow	0.03	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.16	0.21	0.28	0.33	0.39	0.46	0.53	0.60	0.72	1.10
Fallow or Minimum Tillage Cultivation	0.06	0.08	0.10	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.29	0.40	0.51	0.66	0.78	0.91	1.05	1.20	1.44	2.10
Short Grass Pasture or Lawns	0.09	0.13	0.15	0.18	0.20	0.21	0.23	0.25	0.26	0.28	0.45	0.60	0.77	0.96	1.17	1.33	1.50	1.68	1.98	3.20
Almost Bare Ground	0.16	0.22	0.28	0.31	0.35	0.38	0.41	0.44	0.46	0.49	0.70	0.85	1.05	1.26	1.50	1.75	2.03	2.32	2.79	4.40
Grassed Waterway	0.35	0.48	0.58	0.67	0.77	0.84	0.91	0.98	1.05	1.12	1.54	1.82	2.10	2.38	2.78	3.20	3.66	4.14	4.56	7.00
Paved Areas (Sheet Flow) or Shallow Gutter Flow	0.44	0.62	0.77	0.91	1.05	1.12	1.19	1.26	1.33	1.40	2.00	2.55	3.20	3.83	4.41	5.04	5.70	6.00	6.20	9.00

ATTACHMENT F

DETERMINATION OF DIMENSIONLESS
WATERSHED CONVEYANCE FACTOR (Ø)

$$\emptyset = \emptyset_1 + \emptyset_2$$

$\emptyset_1$	Classification
0.6	Extensive channel improvement and storm sewer system, closed conduit channel system
0.7	Moderate channel improvement and storm sewer system.
0.8	Some channel improvement and storm sewers, mainly cleaning and enlargement of existing channel.
0.9	Little channel improvement and storm sewers.
1.0	Natural channel conditions.

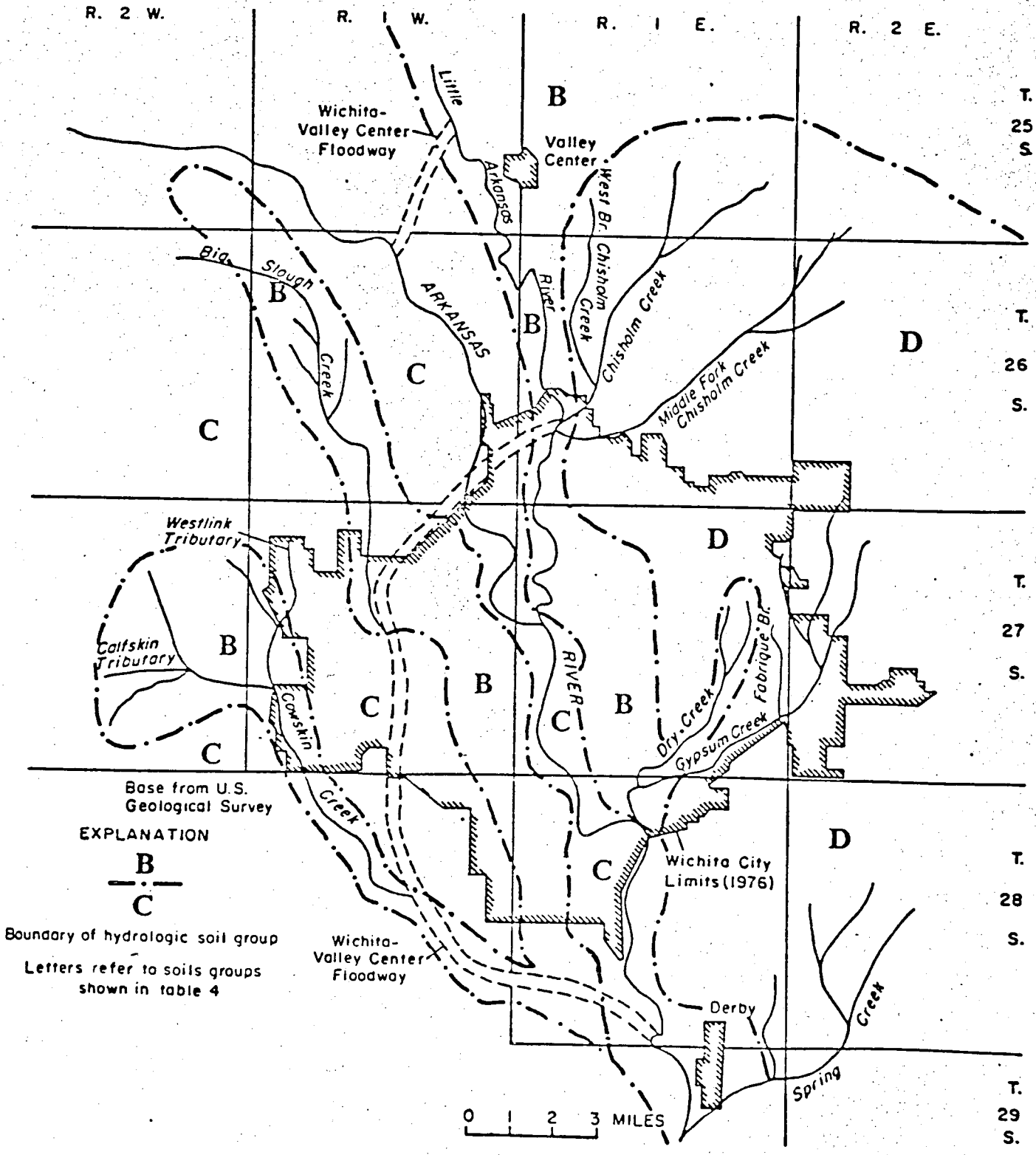
$\emptyset_2$	Classification
0.0	No channel vegetation.
0.1	Light channel vegetation.
0.2	Moderate channel vegetation.
0.3	Heavy channel vegetation.

EXHIBIT NO. 1

SOIL LEGEND

SYMBOL	HYDROLOGIC GROUP	NAME
Aa	B	Albion-Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loans, 7 to 15 percent slopes
Ba	C	Blanket silt loam, 0 to 1 percent slopes
Bb	C	Blanket silt loan, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loan
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	Clime 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 lopes
Wa	C	Waldeck sandy loam
Wb	D	Waurika silt loam

EXHIBIT NO. 2


R. 2 W.
R. 1 W.
R. 1 E.
R. 2 E.
T. 25 S.
T. 26 S.
T. 27 S.
T. 28 S.
T. 29 S.
Little Arkansas River
Wichita-Valley Center Floodway
Valley Center
West Br. Chisholm Creek
Chisholm Creek
Middle Fork Chisholm Creek
Big Slough Creek
ARKANSAS RIVER
Westlink Tributary
Calfskin Tributary
Cowskin Creek
Dry Creek
Gypsum Creek
Fabrique Br.
Wichita City Limits (1976)
Derby
Spring Creek
B
C
D
0 1 2 3 MILES
Base from U.S. Geological Survey
EXPLANATION
B/C
Boundary of hydrologic soil group
Letters refer to soils groups shown in table 4