

DRAINAGE PLAN
AND
SUPPORTING CALCULATIONS

LYNDE INDUSTRIAL ADDITION
SEDGWICK COUNTY, KANSAS

PREPARED BY
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LYNDE INDUSTRIAL ADDITION

DRAINAGE PLAN & SUPPORTING CALCULATIONS

The proposed plat is located in the Southerly part of the N. E. 1/4 of Section 14, T.28 S., R. 1 W., lying between the M.O.P. R/W and West Street.

The road side ditches of West Street and a shallow natural channel bisecting the property are the only existing drainage outlets.

The primary goals of this hydrology evaluation are (1) to determine adequate improved channel capacity to convey the 100 yr. peak discharge from the upstream watershed thru the proposed plat, and in general alignment with the existing natural channel near the middle of the plat, and (2) to provide on-site retention in order that the post-development peak discharge from the site will not exceed the peak discharge from present conditions, for the 100 yr. design storm.

The larger value for the 100 yr. peak discharges as determined by the Rational Method or by SCS TR-55, will be used to determine the geometry of the proposed improved channel.

RATIONAL METHOD - Peak Discharge

Time of Concentration, T_c

In the upper reach of the watershed, there is approximately 600 ft. of overland flow to the point of beginning of shallow channel flow, and from that point approximately 1360 ft. of shallow channel flow to the South line of the proposed plat.

The overland flow time is estimated by the Kinematic Wave equation, as follows:

$$T \text{ (overland flow time)} = 0.93 \times (L)^{0.6} \times (n)^{0.6} / I^{0.4} \times (S)^{0.3}$$

From Table 3-1, TR-55, for cultivated soils with residue cover > 20%, "n" = 0.17; and with L = 600 ft.; S = 0.3%

$$\text{Then, } T \text{ (overland flow time)} = 85.2428 / I^{0.4}$$

Assume I(100 yr.) and check value of time of overland flow against the corresponding duration for the design frequency storm.

From T.P. 40 - NWS Hydro 35, assume I = 4.23 "/hr. = 48 minutes for 100 yr. frequency storm (Attachment "A")

Then, T (overland flow) = $85.2428 / 1.7805 = 47.9$ min.,
 which agrees closely with 48 min., assumed duration.

Shallow Channel Flow Time, is estimated by the average of the
 flow velocities at the upper and lower end of the existing
 natural channel (1360 L.F.).

From Attachment "E", the flow velocity at the upper end is
 estimated to be 0.58 fps. From Mannings, the velocity of
 flow is estimated to be 2.0 fps. at the lower end of the
 channel, for an average of 1.3 fps. Then, travel time =
 $1360 \text{ ft.} / 1.3 \text{ fps.} \times 60 \text{ sec.} / \text{min.} = 17$ minutes.

Then Time of Concentration = overland flow time + channel
 travel time = 48 min. + 17 Min. = 65 minutes.

PEAK DISCHARGE - Rational Method - 100 yr. Storm

$$Q = C \times I \times A = 0.5 \times 3.57 \times 65.8 = 118 \text{ cfs.}$$

S.C.S. - T.R. #55 METHOD. Peak Discharge

Weighted Runoff Curve Number (CN)

Soil Name & Hydro. Group	Cover Description & Hydro. Condition	CN	% of Area	Product of CN x % Area
Tabler (D)	Pasture - Good	80	25%	2,000
Tabler (D)	Small Grain - Poor	88	25%	2,200
Tabler (D)	Pasture - Fair	84	50%	4,200
Totals			100%	8,400

$$\text{Weighted CN} = 8,400 / 100 = 84$$

Time of Concentration

As computed for Rational Method = 65 minutes

Drainage Area = 65.8 Ac. = 0.1028 Sq. Mi.

Design Storm = 5.9 inches (100 yr. - 6 hr.)

Runoff Depth = 4.1 inches (Table 2-1)

Unit Peak Discharge = 239 cfs / sq. mi. / inch runoff
 (Figure 3 - 7)

$$\begin{aligned} \text{Then, Peak Discharge} &= \text{Unit Peak Discharge} \times \text{Area} \times \text{Runoff} \\ &= 239 \text{ cfm} / \text{in} \times 0.1028 \text{ sq. mi.} \times 4.1 \text{ "} \\ &= 101 \text{ cfs.} \end{aligned}$$

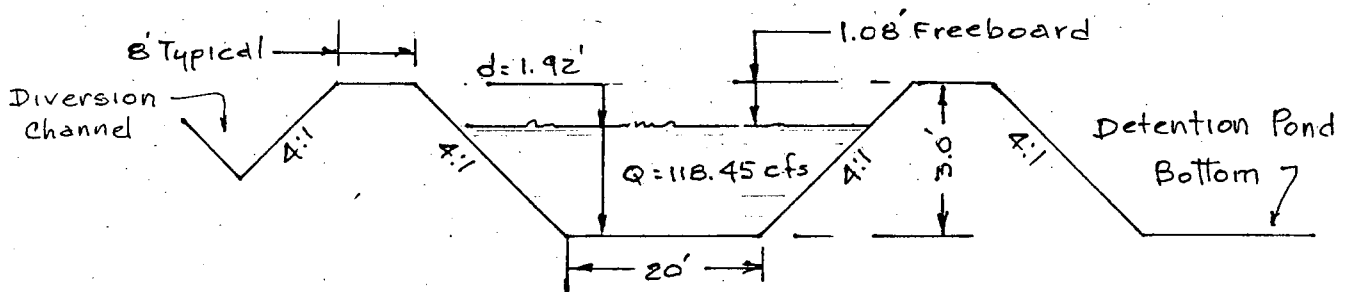
Note: The Peak Discharge by the Rational Method is 16%

larger than by the S.C.S. - T.R. 55 Method, which is in reasonable agreement. The larger value will be used to determine the channel configuration.

CHANNEL CONFIGURATION

The improved channel through this plat will ultimately connect into the improved channel as previously planned and constructed for the plat of J & P Industrial Addition, to the South. The intervening channel length between these two subdivisions is approximately 500 feet, and the planned gradient is 0.12 %.

Then, with "n" = 0.030; S = 0.12 % and Q = 118 cfs., the cross section of the proposed channel was determined from Manning's equation (by iteration), as indicated below.



$$A = 53.1456; WP = 35.8320; R = A / P = 1.4832; R^{0.67} = 1.3005$$

$$S = 0.0012; S^{0.5} = 0.0346$$

$$Q = 1.486 / "n" \times S^{0.5} \times R^{0.67} \times A$$

$$Q = 49.5333 \times 0.0346 \times 1.3005 \times 53.1456$$

$$Q = 118.45 \text{ cfs.}$$

$$\text{Velocity} = 2.22 \text{ fps.}$$

$$\text{Flow Depth} = 1.92 \text{ ft.} \approx (2.0 \text{ ft. in J. \& P. Ind. Add'n})$$

ON - SITE RETENTION

Within the proposed subdivision, the only foreseeable development will be in the part lying East of the proposed drainage channel. Then, both the volume and the peak rate of runoff from the area West of the channel will be the same for both present and future conditions. Retention storage and outlet device are to be provided for the East parcel that will limit the post development discharge to that of present condition discharge.

PEAK DISCHARGE - Present Condition, East Parcel

Time of Concentration, Tc

Under present conditions, the hydraulically longest flow path is approximately 370 ft. of overland flow to the existing natural channel.

With "n" = 0.15; L = 370 ft.; S = 2.3 / 370 = 0.6 %

$$T \text{ (overland flow time)} = 0.93 \times (L)^{0.6} \times (n)^{0.6} / (I)^{0.4} \times (S)^{0.3}$$

$$\text{Then, } T \text{ (overland flow time)} = 47.88 / I^{0.4}$$

Assume 100 yr. rainfall (I), and check value of time of overland flow against the corresponding duration for the assumed rainfall intensity.

Assume I = 6.13 in. / hr. = 23 minutes duration for the 100 yr. storm. (T.P. 40 - Attachment "A")

$$\text{Then, } T \text{ (overland flow time)} = 47.88 / 6.13^{0.4} = 23.2 \text{ min.,}$$

which agrees closely with the assumed duration of 23 minutes.

Time of Concentration = overland flow time = 23 minutes, and the corresponding 100 yr. rainfall intensity = 6.13 in / hr.

The Rational Coefficient, "C" = 0.63 (C. of W. Drg. Policy)

Drainage Area, "A" = 2.63 Ac.

PEAK DISCHARGE - Rational Method - Present condition

$$Q = C \times I \times A = 0.63 \times 6.13 \times 2.63 = 10.16 \text{ cfs.}$$

PEAK DISCHARGE - Developed Conditions, East Parcel

Time of Concentration

The longest flow path will be altered upon development, with 220 ft. of overland flow and 260 ft. of flow over impervious surfaces. The slope overland will be 0.77 % , and the "n" value will be 0.15.

$$\text{Then, } T_o = 0.93 \times 25.44 \times 0.32 / I^{0.4} \times 0.2322$$

$$T_o = 32.61 / I^{0.4}$$

Assume I = 7.37 in / hr, and corresponding 15 min. duration.

Then, $T_o = 32.61 / 2.2232 = 14.67 \text{ min.} = 15 \text{ min.}$ (assumed)

Flow over impervious surfaces is estimated at 2 fps. Then, travel time, $T_t = 260 / 2\text{fps} \times 60 \text{ sec.} / \text{min.} = 2 \text{ minutes.}$

Time of Concentration = overland flow time + travel time over impervious surfaces = $15 + 2 = 17 \text{ minutes.}$

Rainfall Intensity, for $T_c = 17 \text{ minutes}$, the 100 yr. rainfall $I = 7.0 \text{ in.} / \text{hr.}$

Rational Coefficient, "C" (Weighted)

Roof Area = 0.34 Ac. = 13 % total area, $w / C = 0.93$

Drives and parking lots = 0.29 Ac. = 11 % Area, $w / C = 0.89$

Lawn, Soil Group "D" $w / < 1 \%$ slope

= 0.76 % of total area, $w / C = 0.63$

Then, weighted "C" = 0.70

Drainage Area, East parcel = 2.63 Ac.

PEAK DISCHARGE - East Parcel, Rational Method

$$Q = C \times I \times A = 0.70 \times 7.0 \times 2.63 = 12.89 \text{ cfs.}$$

FLOOD ROUTING The following calculations are to determine routing of peak discharge from developed conditions (12.9 cfs) through the detention pond, with a design outlet limited to the present condition peak discharge (10.16 cfs).

Because of grading limitations, approximately 1.54 cfs of the developed condition discharge will drain into the West Street ditch, and therefore the design discharge of 10.16 cfs from the detention pond will be reduced by 1.54 cfs, or approximately 8.6 cfs.

Due to depth limitations of approximately 2 ft. for the detention pond, an 18" CMP culvert is investigated as the outlet device, which will discharge approximately 8.2 cfs with an anticipated head of 2 feet.

Supporting graphs and calculations are shown on the following pages.

SUMMARY

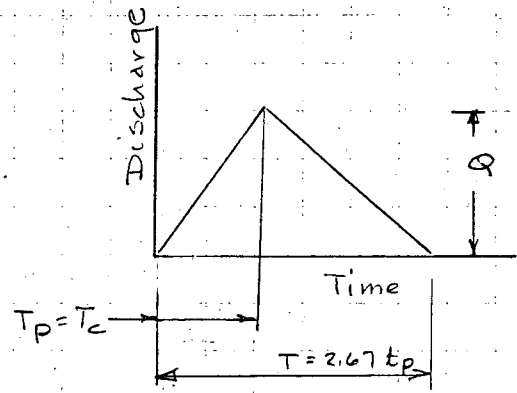
The plan elevation for the bottom of the detention pond is 1279.0 MSL, and the maximum stage from the flood routing is 2.01 ft., and the DWS elevation of the pond will be 1281.01 MSL.

TRIANGULAR HYDROGRAPH

EAST PARCEL

DEVELOPED CONDITIONS

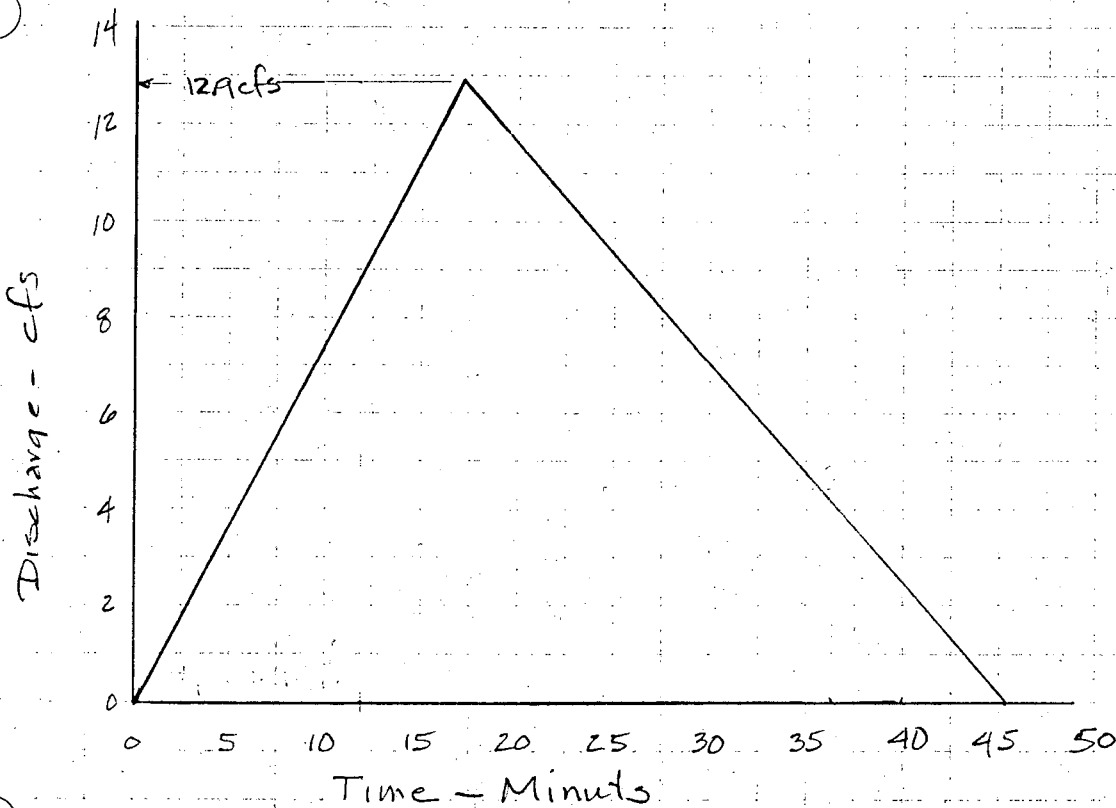
$$D.A. = 2.63 A_c$$



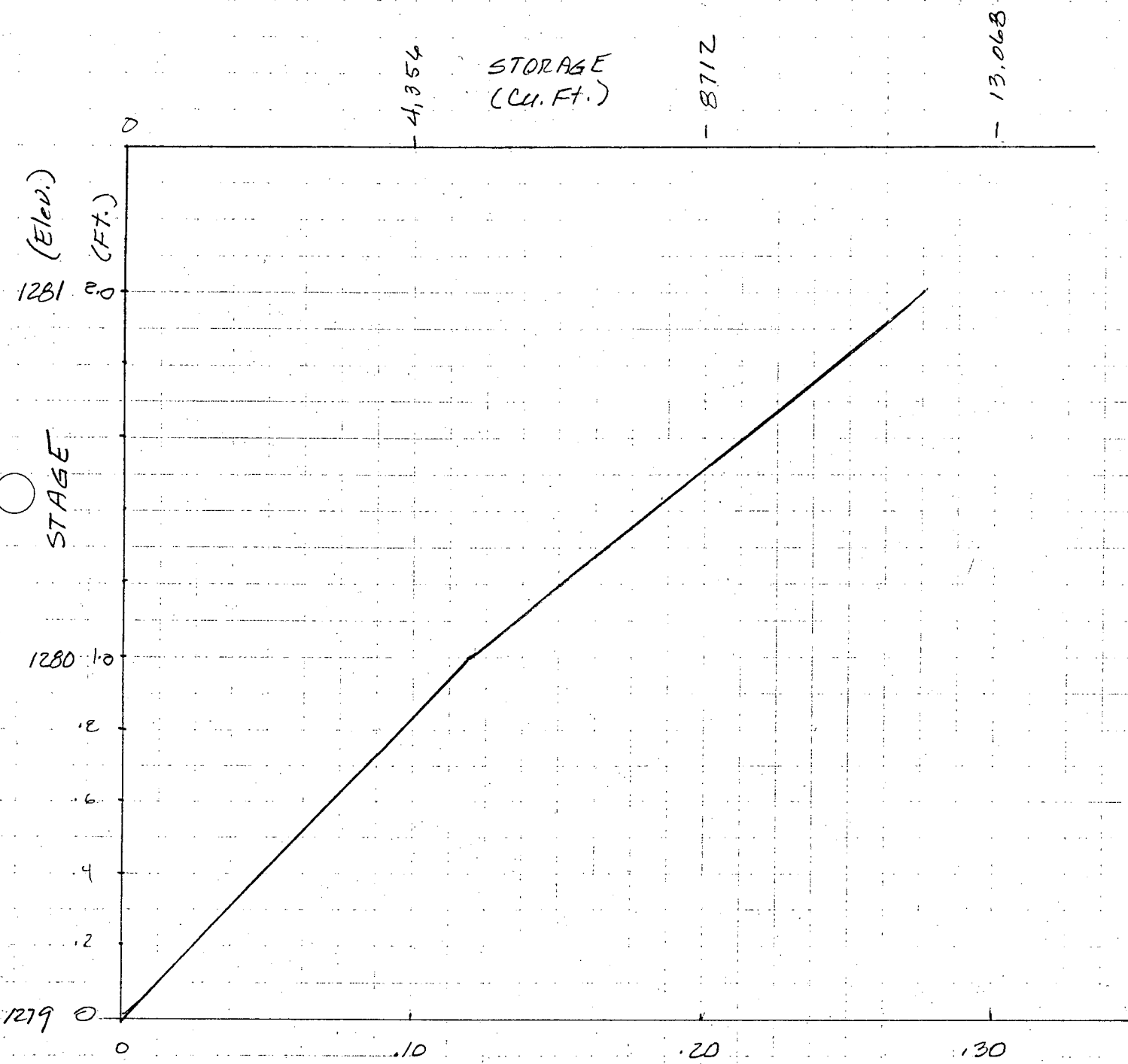
$$T_c = T_p = 17 \text{ min.}$$

$$T_b = 2.67 T_p = 45.3 \text{ min.}$$

$$Q_p = 12.9 \text{ cfs}$$



STAGE-STORAGE CURVE



4,954

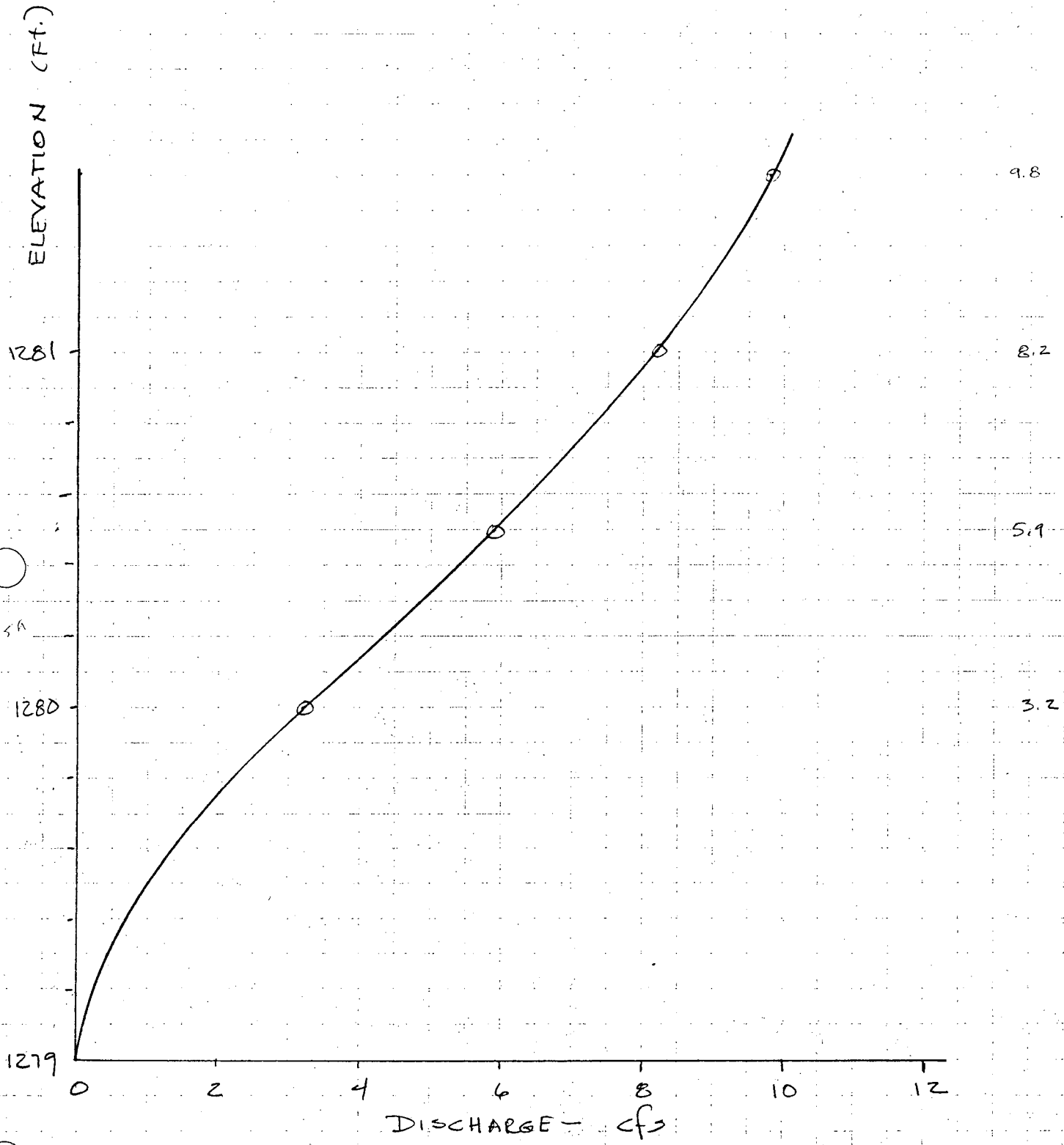
8712

13,068

STORAGE - Ac-Ft.

H - 1" = 0.50 Ac Ft
 V - 1" = 0.40 Ft.

STAGE - DISCHARGE (18" CMP)
CURVE

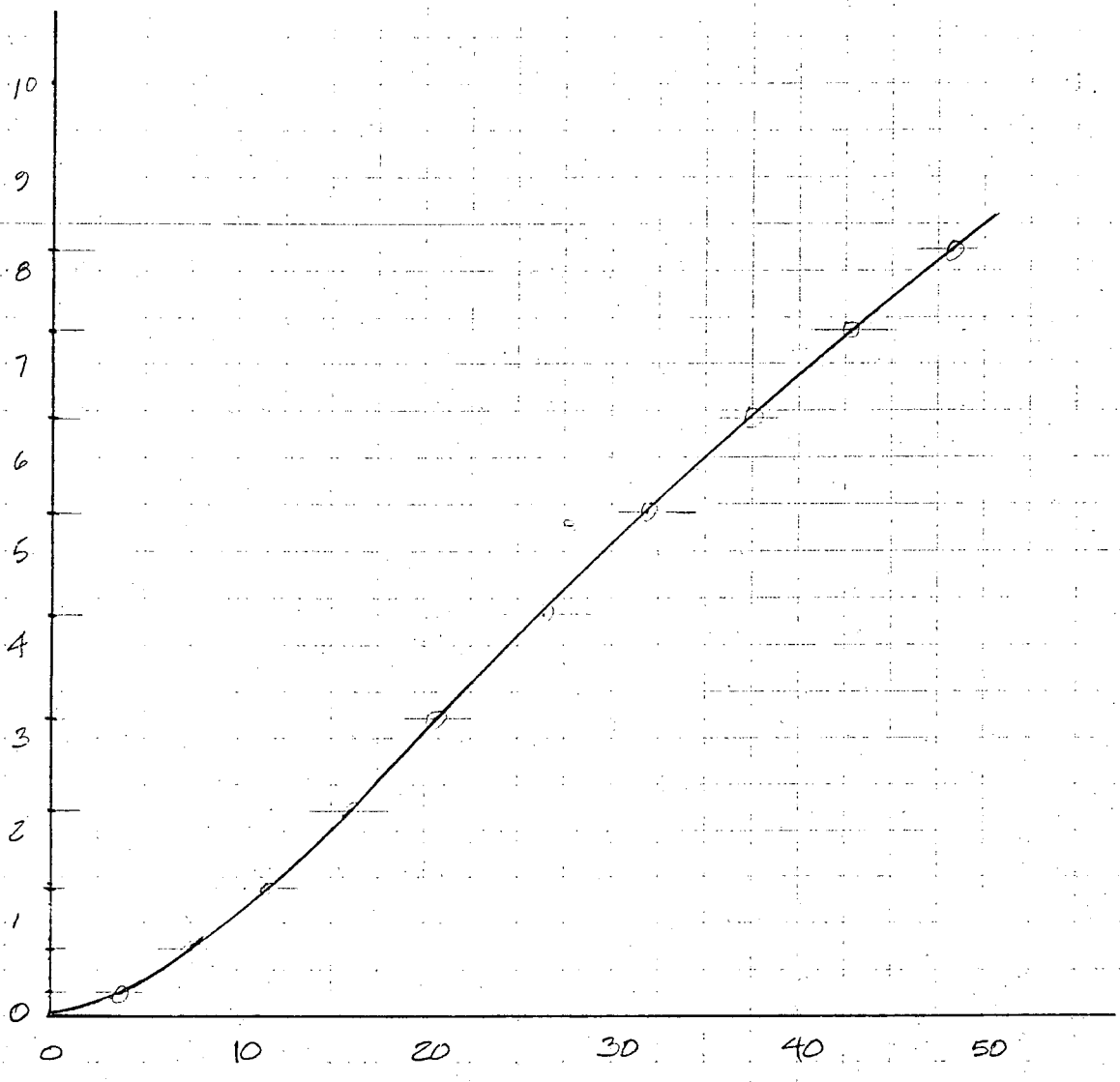


VALUES OF STORAGE, OUTFLOW, AND $(2S/\Delta t) + O$; $\Delta t = 10 \text{ Min.}$
 $= 0.167 \text{ hrs}$

STAGE (ft.)	STORAGE (Cu. Ft.)	OUTFLOW (cfs)	$2S/\Delta t + O$ (cfs)
0	0	0	0
0.2	1,089	0.25	3.81
0.4	2,091	0.70	7.66
0.6	3,134	1.35	10.43
0.8	4,182	2.20	14.11
1.0	5,227	3.20	20.59
1.2	6,621	4.30	26.33
1.4	7,971	5.38	31.90
1.6	9,322	6.40	37.41
1.8	10,672	7.32	42.82
2.0	12,023	8.20	48.20
2.2	13,373	8.85	53.43
2.4	14,723	9.50	58.48

1" = 2 cfs

OUTFLOW - Discharge - cfs (18" CMP)



$z_s/at + 0$ (cfs)

$\Delta_x = 0.167 = 10 \text{ min.}$

(1) Time (hrs)	(2) $I_x = I_{in}(flow)$ (cfs)	(3) $I_x + I_{x+\Delta t}$ (cfs)	(4) ^{3rd} O = Outflow (cfs)	(5) ^{4th} $2S/\Delta t - O$ (cfs)	(6) ^{1st} $2S/\Delta t + O$ (cfs)	(7) ^{2nd} Stage (ft)
0	0	3.7	0	0	0	0
0.0833	3.7	11.3	1.48	8.34	11.3	0.63
0.167	7.4	19.0	4.49	18.36	27.34	1.24
0.25	11.4	23.1	7.09	27.28	41.46	1.75
0.33	11.7	21.05	8.22	31.89	48.33	2.01
0.414	9.35	16.40	8.21	31.87	48.29	2.00
0.50	7.05	11.80	7.47	28.73	43.67	1.83
0.583	4.75	7.25	6.14	23.70	35.98	1.55
0.67	2.5	2.7	4.31	17.78	26.40	1.20
0.75	0.2	0.2	2.62	12.74	17.98	0.88
0.833	0	0	1.70	9.34	12.74	0.68
0.917	0	0	1.09	7.16	9.34	0.52
1.00	0	0	0.64	5.88	7.16	0.37
1.083	0	0	0.49	4.90	5.88	0.31
1.167	0	0				

TABULAR ROUTING OF DEVELOPED
DISCHARGE THRU DETENTION BASIN

$Q_{100} = 17 \text{ cfs}$

Outlet Device = 18" C.M.F

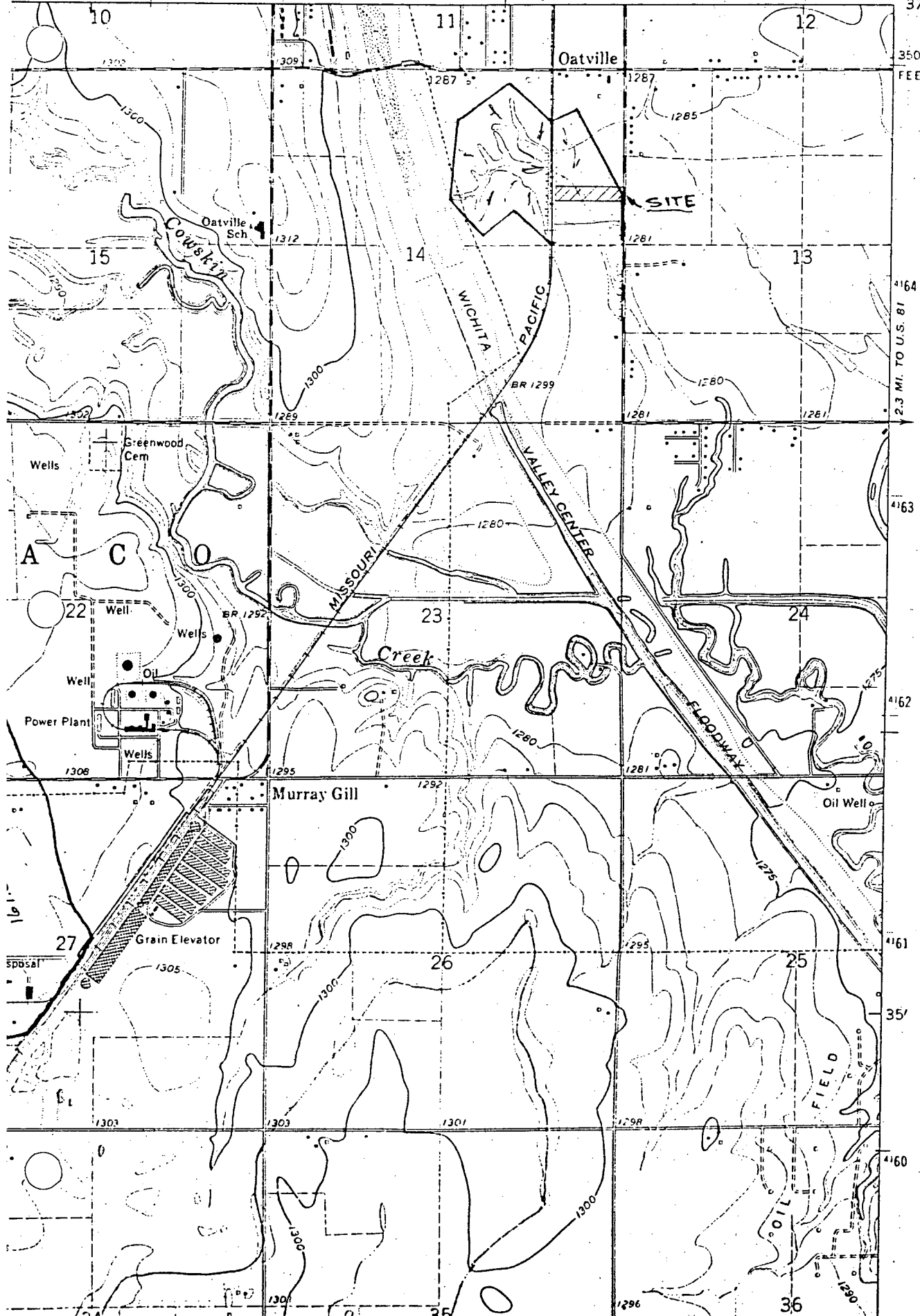
POND BOTTOM = 129.7 M.S.L.

Max. Stage Detention Basin = 128.1 M.S.L.

BAYNEVILLE QUADRANGLE
KANSAS-SEDGWICK CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

R539 III NE
(WICHITA EAST)

25' 40 61 2 320,000 FEET 43 97°22'30" 37°37'30"



J-10-11

- 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

<u>DURATION IN MINUTES</u>	<u>RETURN PERIODS OF</u>						
	<u>1-YR</u>	<u>2-YR</u>	<u>5-YR</u>	<u>10-YR</u>	<u>25-YR</u>	<u>50-YR</u>	<u>100-YR</u>
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

<u>DURATION IN MINUTES</u>	<u>RETURN PERIODS OF</u>						
	<u>1-YR</u>	<u>2-YR</u>	<u>5-YR</u>	<u>10-YR</u>	<u>25-YR</u>	<u>50-YR</u>	<u>100-YR</u>
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

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

Table 2-2a.—Runoff curve numbers for urban areas¹

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area ²	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ³ :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%).....		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ⁴ ...		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) ⁵		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

¹Average runoff condition, and $I_a = 0.2S$.

²The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

³CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

⁴Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

⁵Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c.—Runoff curve numbers for other agricultural lands¹

Cover description	Hydrologic condition	Curve numbers for hydrologic soil group—			
		A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. ²	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. ³	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30	48	65	73
Woods—grass combination (orchard or tree farm). ⁵	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. ⁶	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

¹Average runoff condition, and $I_p = 0.2S$.

²*Poor:* < 50% ground cover or heavily grazed with no mulch.

Fair: 50 to 75% ground cover and not heavily grazed.

Good: > 75% ground cover and lightly or only occasionally grazed.

³*Poor:* < 50% ground cover.

Fair: 50 to 75% ground cover.

Good: > 75% ground cover.

⁴Actual curve number is less than 30; use CN = 30 for runoff computations.

⁵CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

⁶*Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.

Fair: Woods are grazed but not burned, and some forest litter covers the soil.

Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

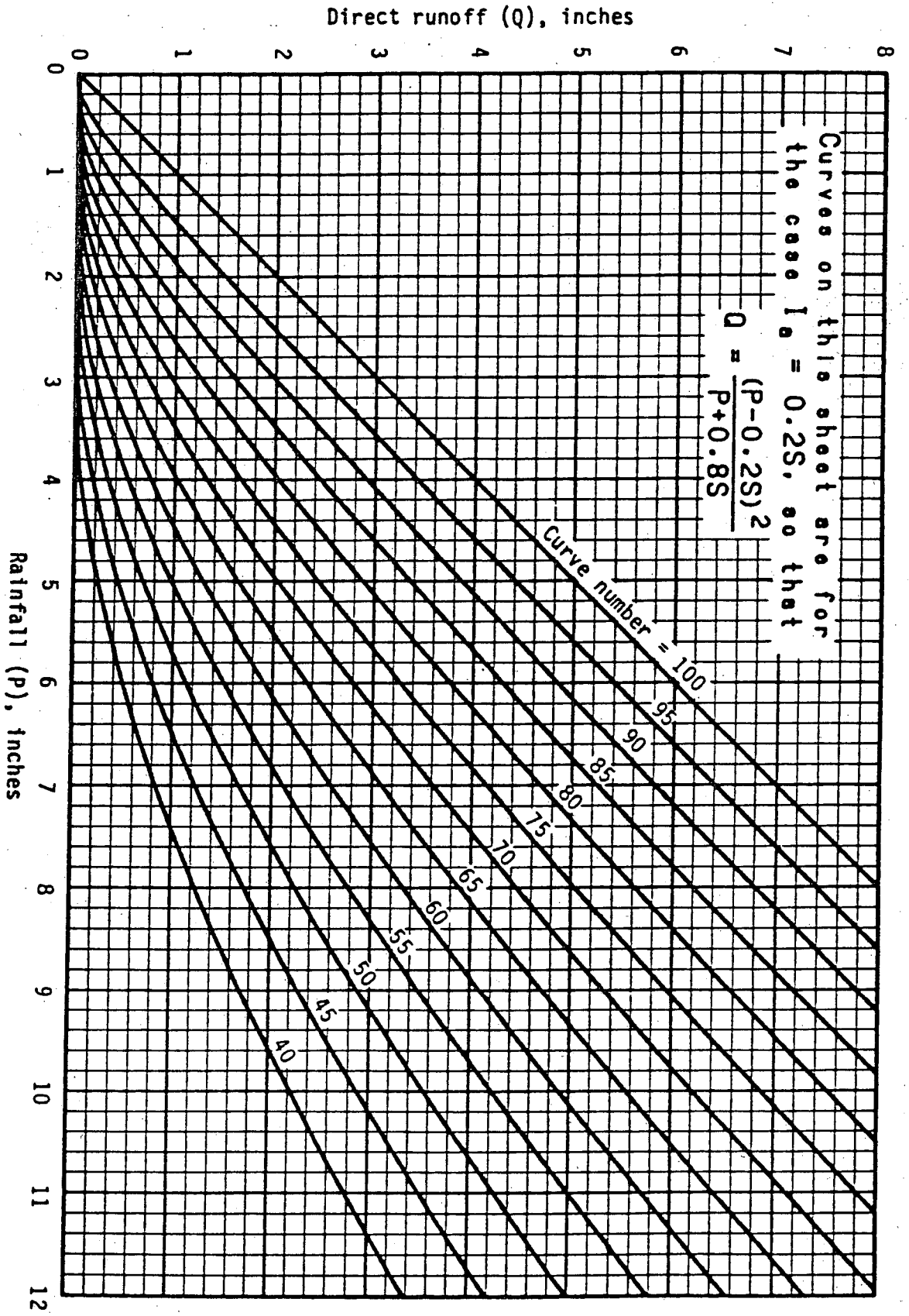


Figure 2-1.—Solution of runoff equation.

2. PEAK RATE (CONT'D)

100 Year - 6 hour Storm

Unit Peak Discharge Versus Time of Concentration, Zone 1

T_c (hours)	q cfs/(mi ²)(in) ^{1/}	T_c (hours)	q cfs/(mi ²)(in) ^{1/}
0.10	680	0.5	335
0.12	620	0.6	310
0.14	580	0.7	290
0.16	550	0.8	275
0.18	520	0.9	260
0.20	500	1.0	245
0.22	480	1.2	230
0.24	460	1.4	215
0.26	440	1.6	200
0.28	430	1.8	190
0.30	420	2.0	180
0.32	410	2.5	160
0.34	400	3.0	145
0.36	390	3.5	130
0.38	380	4.0	120
0.40	370	4.5	110
0.42	360	5.0	100
0.44	350	5.5	95
0.46	345	6.0	90
0.48	340		

1/ (in) = acre inch runoff per acre.

Figure 3.7