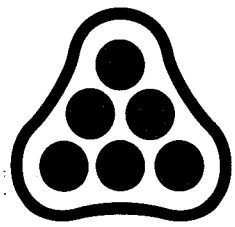

PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

COUNTRY MEADOWS WEST ADDITION

SEDGWICK COUNTY, KS

APRIL 15, 1996

303 S. TOPEKA
WICHITA, KANSAS 67202
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COUNTRY MEADOWS WEST ADDITION

SEDGWICK COUNTY, KANSAS

4/15/96

Country Meadows West Addition is single family residential development West of Wichita in Sedgwick County, Kansas encompassing approximately 10 acres. The computations and supporting data for the drainage plan of Country Meadows West Addition plat are presented herein.

Hydrology

The Rational Method has been used for hydrologic analysis of all storm sewer systems that serve the residential streets and yards. The analysis made is based on the available site data which includes the following: 1" = 100' topographic map with 2' contours of the site and adjacent areas; Sedgwick County Soil Survey Map; Plans for City of Wichita Project No. 472-82411 (Central Avenue Improvements); Bay Country Addition drainage plan dated April 27, 1987. Detention storage is not required for this plat because ponds in the Bay Country Addition drainage plan were design for future developments North of Central Avenue. The computations herein show the estimated drainage area and major flow is less than that shown on the Bay Country Addition drainage plan for future development.

Inlet Design

For local street conveyance, curb-deep flow is tolerable for the minor, or 2 year storm. For each inlet, street flooding and inlet capacity has been checked for the minor storm. It has been assumed 3/8 in./ft. street cross-slopes, City of Wichita 6-5/8" standard curb and gutter and Type 1A street inlets will be used throughout. Minimum walk grade has been assumed to be 0.41 feet above top of curb unless otherwise noted. A "cascade effect" has been designed to provide a drainage release point in the event of system failure.

Pipe Design

Hydraulic computations for the pipe system were performed using Manning's Equation. All pipes were assumed to be reinforced concrete with a Manning's "n" factor of 0.013. It has been checked to be certain the hydraulic grade line is approximately one foot below the top of curb elevations for the minor storm. The

system is designed for the minor storm or 2 year storm, and has major storm overflow directed to the pond south of Central Avenue in Bay Country Addition. Coordination with the City of Wichita must be done in regard to the re-design of proposed storm sewer in Central Avenue so that proper flow line alignments are maintained to pond outfall in Bay Country Addition.

To simplify analysis the following assumptions were made:

1. The time of concentration is identical for both pipe flow and street flow for both major and minor storm; a conservative estimate since pipe velocities generally exceed gutter velocities.

2. Street conveyance was analyzed using only the street width. Depths above curb up to the walk grade were used, but the conveyance of the parking was neglected. In general, the parking area conveyance is quite small, due to a relatively higher "n" factor.

Design Aids

This section includes material used to assist in designing the drainage system. A 1"=100' scale drainage plan map is enclosed in the pocket.

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COUNTRY MEADOWS WEST ADDITION

HYDROLOGY

4/15/96

BASIN #	AREA (ac)	C2	C100	tc	i2 (in/hr)	i100 (in/hr)	Q2 (cfs)	Q100 (cfs)
A*	7.87	0.48	0.68	15	3.83	7.37	14.58	39.76
B*	2.85	0.48	0.68	15	3.83	7.37	5.28	14.40
C#	2.34	0.49	0.72	15	3.83	7.37	4.43	12.52
D*	2.34	0.48	0.68	15	3.83	7.37	4.34	11.82
E+	4.13	0.42	0.72	15	3.83	7.37	6.70	22.09

* - Runoff coefficient based on class C soils and 1/4 acre lots.
# - Weighted runoff coefficient based on class C & D soils on 1/4 acre lots.
+ - Runoff coefficient based on class D soils and 1/2 acre lots.

Total Area= 19.53 Acres

Total Q2= 35.32 cfs

Total Q100= 100.58 cfs

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COUNTRY MEADOWS WEST ADDITION

STREET FLOW AND INLET DESIGN

4/15/96

Comp by: PDM

Design Storm = Q 2 z=(1/Sx)/n= 2000

Hydrology			Approaching Flow				Inlet		On-Grade Inlet			Sump Inlet				
Node/ Basin	Initial Flow Qo (cfs)	Total Flow Qo+Qb (cfs)	C&G Slope So (%)	X-Slope Sx (in/ft)	Depth d (ft)	Spread T (ft)	Type	Length L (ft)	Slot Length Lt (ft)	L/Lt	Efficiency E	Sump Depth di (ft)	Curb Depth d (ft)	Spread T (ft)	Intercept Qi (cfs)	Bypass Qb (cfs)
A	14.58	14.58	0.32	0.0313	0.52	19.00										
104							1A	10				0.60	0.43	13.87	14.58	0.00
B	5.28	5.28	0.32	0.0313	0.37	13.00										
103							1A	5				0.41	0.24	7.79	5.28	0.00
C(N)	4.43	4.43	0.38	0.0313	0.33	12.00										
E(W)	6.70	6.70	0.38	0.0313	0.38	14.00										
102	11.13	11.13					1A	10				0.51	0.34	10.99	11.13	0.00
D	4.34	4.34	0.38	0.0313	0.33	12.00										
101							1A	5				0.37	0.20	6.51	4.34	0.00

Maximum Street Flow (1/2 Street)

** 58 ft R.O.W.- 29 ft Back-Back Curb

** 14.5 ft Parking w/ 3/8" slope to street.

** Standard C.O.W. 6 5/8" Curb

At Top of Curb: Q2

$$Q_{max} = \frac{0.56}{n} Sx^{5/3} T^{8/3} \sqrt{So} = \quad 12.62 \text{ cfs}$$

At Walk Grade (TC +.41) Q100

$$Q_{max} = \frac{0.56}{n} Sx^{5/3} T^{8/3} \sqrt{So} = \quad 44.87 \text{ cfs}$$

Inlet Design

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COUNTRY MEADOWS WEST ADDITION

PIPE SIZING ESTIMATES

4/15/96

Starting HGL Elev = 50.5 @ Outlet

Begin Node	End Node	Length (ft)	Est. Dia. (in)	Bend (°)	Q2 (cfs)	T.C. Elev. (ft)	F.L. Elev. (ft)	Min Slope (%)
104	103	30.0	24	90	14.58	54.34	50.08	0.42
103	101	670.0	30	95	19.86	54.34	49.28	0.24
102	101	30.0	24	5	11.13	52.90	47.98	0.29
101	100	140.0	36	95	35.33	52.90	47.77	0.15
100	99	120.0	36	0	35.33	54.00	47.50	0.12

Date: 04-15-1996
Time: 09:12:57

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COUNTRY MEADOWS WEST ADDITION
SUBJECT TO CHANGE IN COORDINATION WITH
CITY OF WICHITA PROJECT NO. 472-82411
SEC 13, T27S, R2W
PDM 4/15/96

Storm Frequency = 2-Year

* * * H Y D R O L O G Y * * *

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)
100	99	.00	.00	.00	.0	.00	.00	.00	18.35	3.48	.00	34.13	36"	4.83	120.00	.41	18.77
101	100	.00	.00	.00	.0	15.00	3.83	4.34	17.87	3.53	4.00	34.13	36"	4.83	140.00	.48	18.35
102	101	.00	.00	.00	.0	15.00	3.83	11.13	15.00	3.83	11.13	11.13	24"	3.54	30.00	.14	15.14
103	101	.00	.00	.00	.0	15.00	3.83	5.28	15.11	3.82	5.26	19.84	30"	4.04	670.00	2.76	17.87
104	103	.00	.00	.00	.0	15.00	3.83	14.58	15.00	3.83	14.58	14.58	24"	4.64	30.00	.11	15.11

Date: 04-15-1996
Time: 09:12:57

Input File: cmwa.stm

COUNTRY MEADOWS WEST ADDITION
SUBJECT TO CHANGE IN COORDINATION WITH
CITY OF WICHITA PROJECT NO. 472-82411
SEC 13, T27S, R2W
PDM 4/15/96

Storm Frequency = 2-Year

* * * H Y D R A U L I C S * * *

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)
99	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	50.5000	51.0000	.50
100	.00262	.3143	.0000	.0000	.0181	.1932	.0131	.5387	51.0387	54.0000	2.96
101	.00262	.3667	.0000	.0108	.0000	.1354	.2480	.7609	51.7996	52.9000	1.10
102	.00242	.0726	.0000	.0000	.0000	.0000	.0000	.0726	51.8722	52.9000	1.03
103	.00234	1.5680	.0000	.0161	.0000	.1672	.1132	1.8646	53.6643	54.3400	.68
104	.00415	.1246	.0000	.0000	.0000	.0000	.0000	.1246	53.7889	54.3400	.55

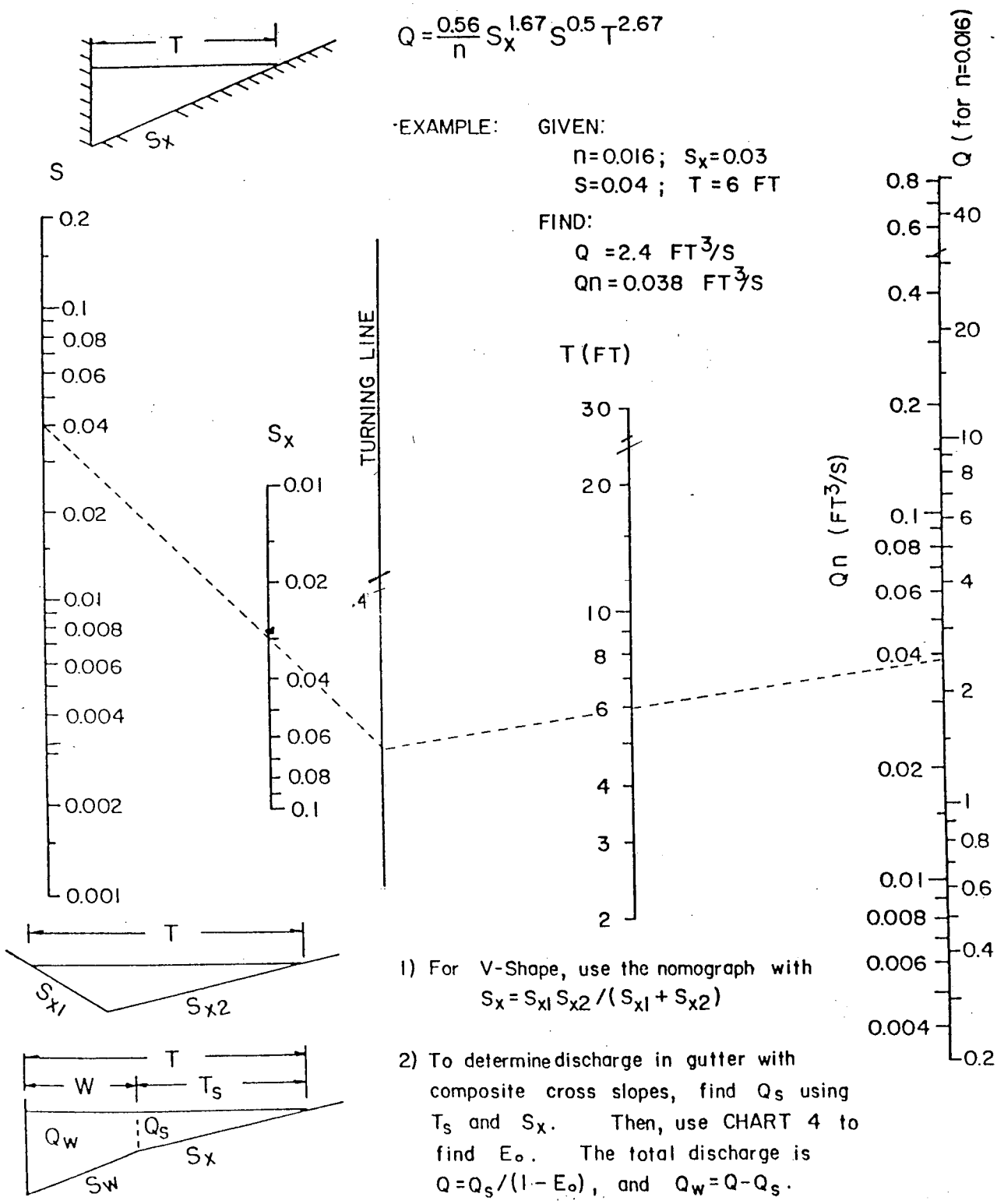
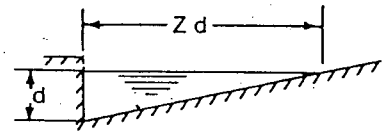


CHART 3. Flow in triangular gutter sections.

FROM: HEC-12: DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., Mar. 1978



Equation: $Q = 0.56 \left(\frac{Z}{n}\right) s^{1/2} d^{8/3}$

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 dashed lines)

Given: s = 0.03
z = 24 } z/n = 1200
n = .02
d = 0.22

Find: Q = 2.0 CFS

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

TURNING LINE

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

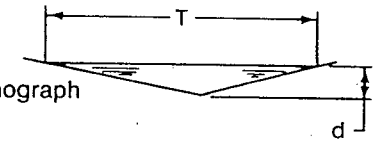
SLOPE OF CHANNEL (S) IN FT./FT.: .10, .08, .07, .06, .05, .04, .03, .02, .01, .008, .007, .006, .005, .004, .003, .002, .001

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

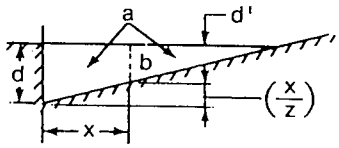
1. Connect z/n ratio with slope (s) and connect discharge (Q) with depth (d). These two lines must intersect at turning line for complete solution.

2. For shallow v-shaped channel as shown use nomograph with $z = \frac{T}{d}$

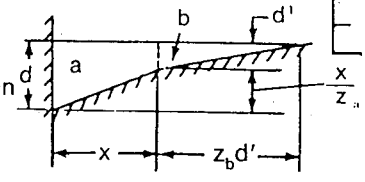


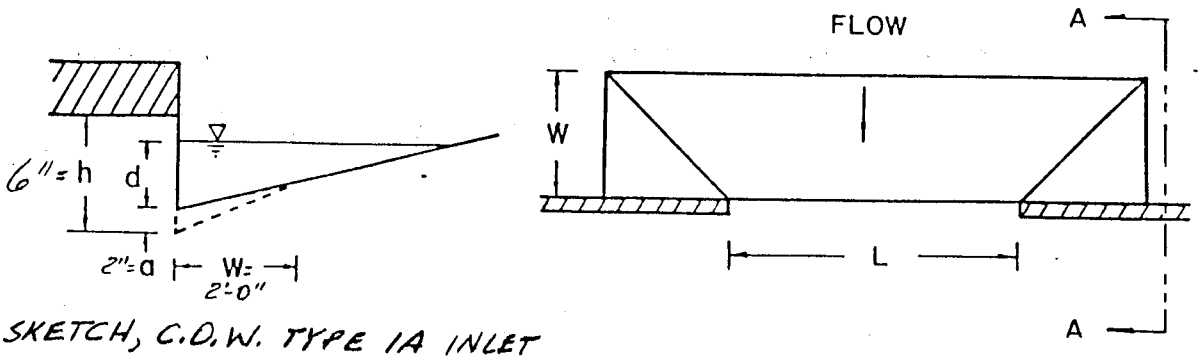
3. To determine discharge Q_x, in portion of channel having width x: determine depth d for total discharge in entire section a. Then use nomograph to determine Q_b, in section b for depth.

$d' = d - \left(\frac{x}{z}\right)$



4. To determine discharge in composite section: – follow instruction 3. To obtain discharge in section a at assumed depth d: obtain Q_b for slope ration Z_b and depth d^1, then $Q_T = Q_a \bullet Q_b$





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

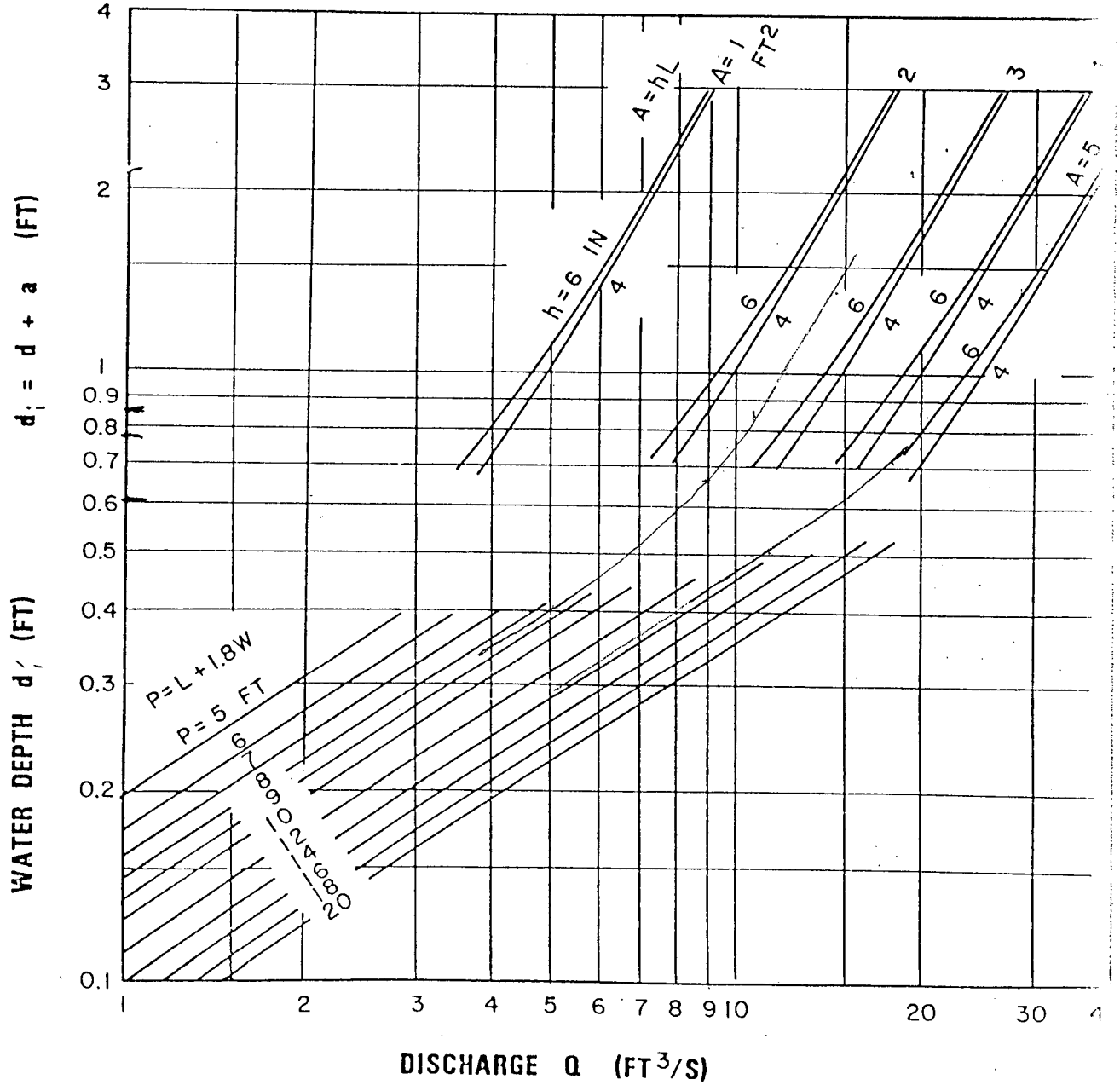


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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

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

TABLE 3

FULL FLOW COEFFICIENT VALUES
CIRCULAR CONCRETE PIPE

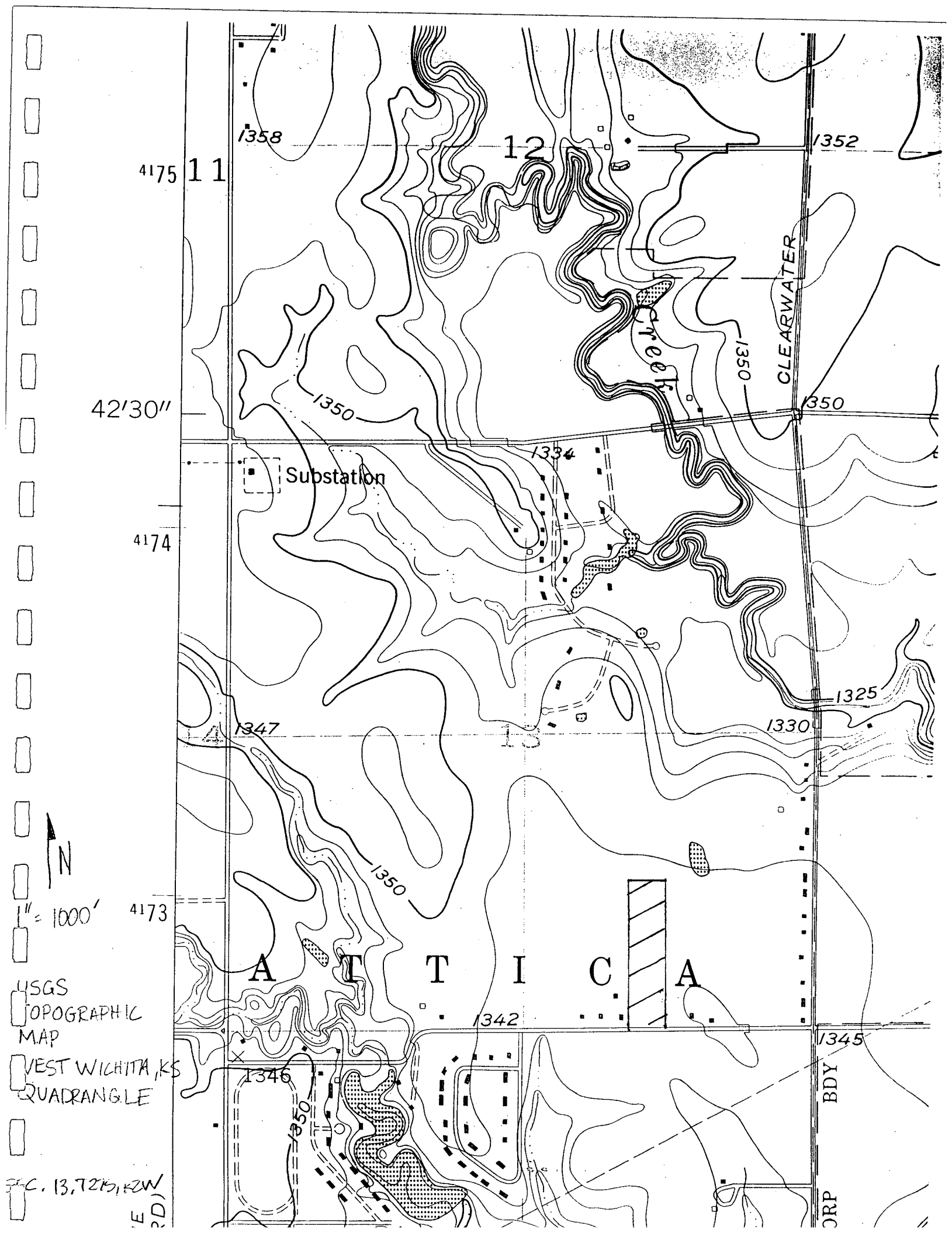
D Pipe Diameter (inches)	A Area (Square Feet)	R Hydraulic Radius (Feet)	Value of $C_1 = \frac{1.486}{n} \times A \times R^{2/3} = K$			
			n=0.010	n=0.011	n=0.012	n=0.013
8	0.349	0.167	15.8	14.3	13.1	12.1
10	0.545	0.208	28.4	25.8	23.6	21.8
12	0.785	0.250	46.4	42.1	38.6	35.7
15	1.227	0.312	84.1	76.5	70.1	64.7
18	1.767	0.375	137	124	114	105
21	2.405	0.437	206	187	172	158
24	3.142	0.500	294	267	245	226
27	3.976	0.562	402	366	335	310
30	4.909	0.625	533	485	444	410
33	5.940	0.688	686	624	574	530
36	7.069	0.750	867	788	722	666
42	9.621	0.875	1308	1189	1090	1006
48	12.566	1.000	1867	1698	1556	1436
54	15.904	1.125	2557	2325	2131	1967
60	19.635	1.250	3385	3077	2821	2604
66	23.758	1.375	4364	3967	3636	3357
72	28.274	1.500	5504	5004	4587	4234
78	33.183	1.625	6815	6195	5679	5242
84	38.485	1.750	8304	7549	6920	6388
90	44.170	1.875	9985	9078	8321	7681
96	50.266	2.000	11850	10780	9878	9119
102	56.745	2.125	13940	12670	11620	10720
108	63.617	2.250	16230	14760	13530	12490
114	70.882	2.375	18750	17040	15620	14420
120	78.540	2.500	21500	19540	17920	16540
126	86.590	2.625	24480	22260	20400	18830
132	95.033	2.750	27720	25200	23100	21330
138	103.870	2.875	31210	28370	26010	24010
144	113.100	3.000	34960	31780	29130	26890

$Q = K\sqrt{S}$

$K = \frac{Q}{\sqrt{S}}$ $\quad S = \frac{Q^2}{K^2}$

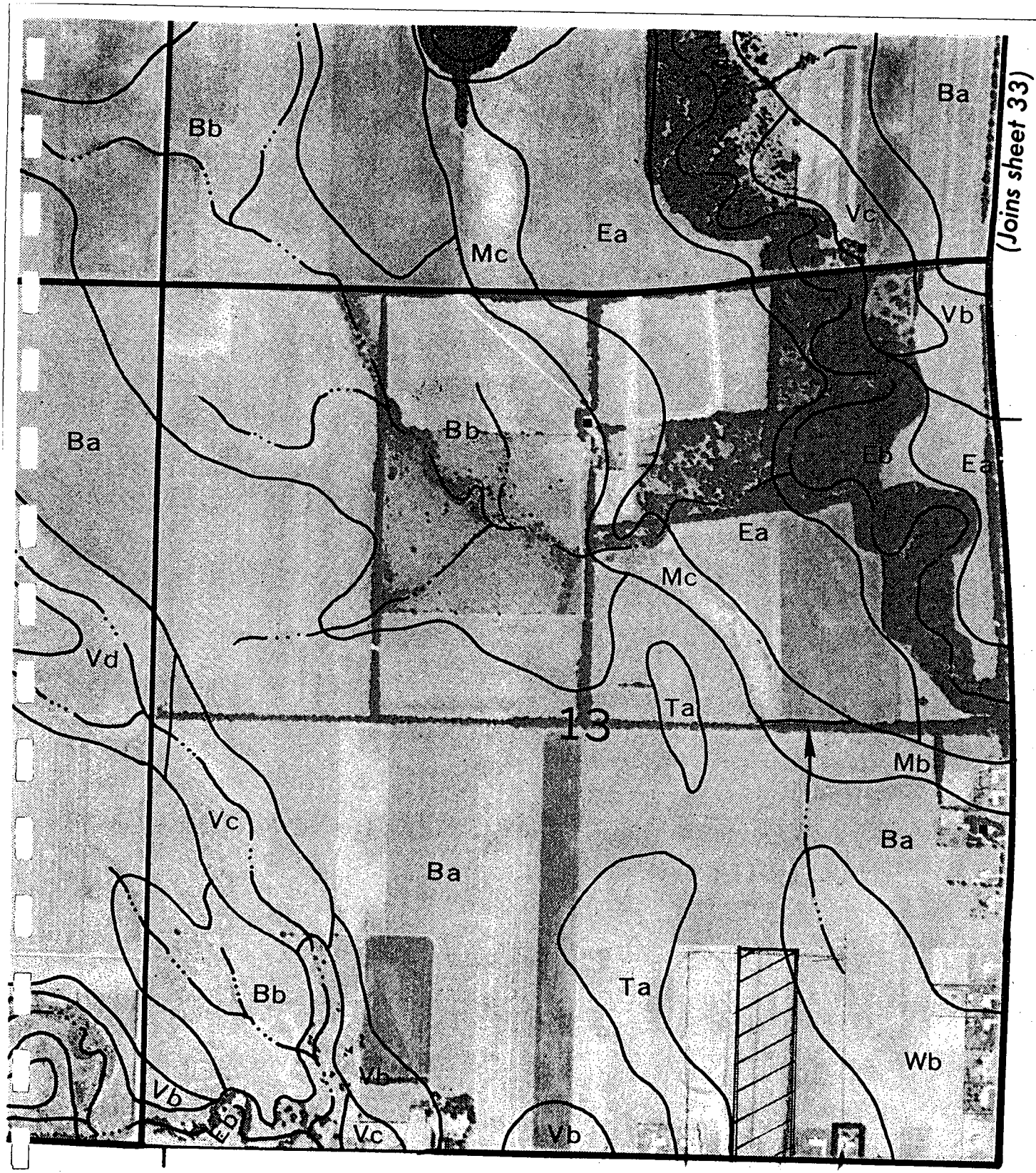
ATTACHMENT A CONTINUED
Page 2

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.
63	1.34	1.63	2.09	2.46	2.89	3.28	3



USGS
TOPOGRAPHIC
MAP
WEST WICHITA, KS
QUADRANGLE

SEC. 13, T21S, R2W



SEC. 13, T.27S, R2W

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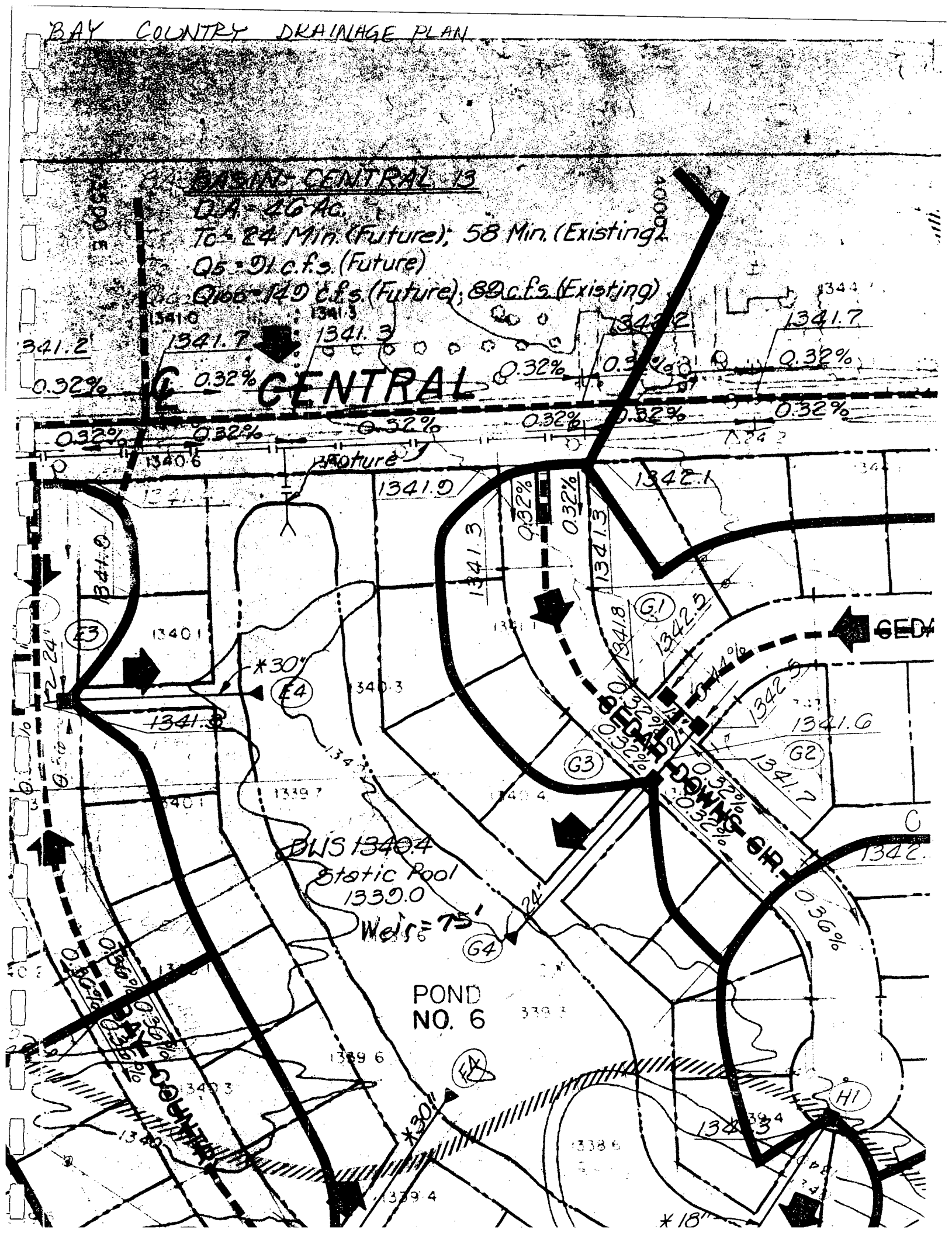
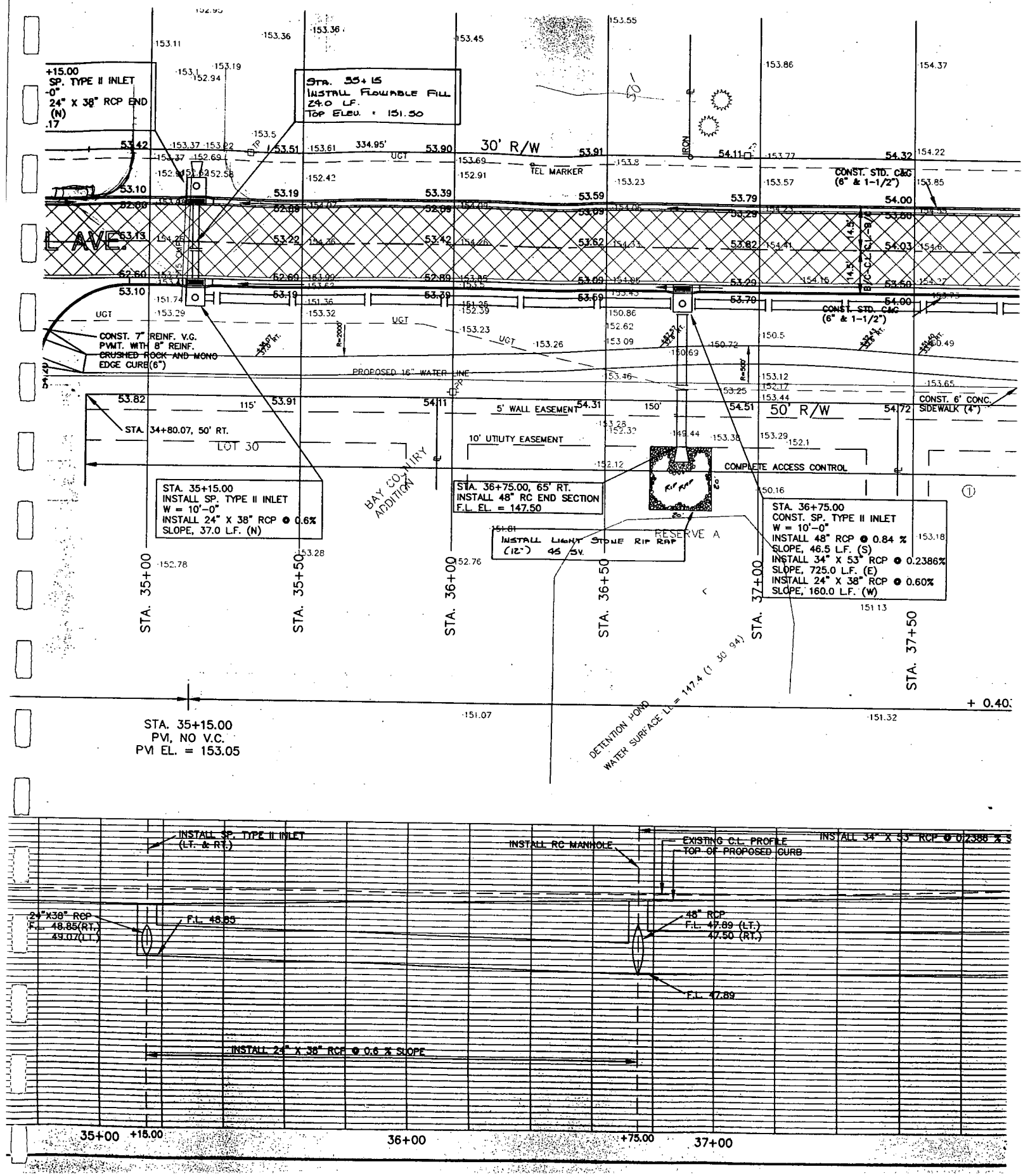
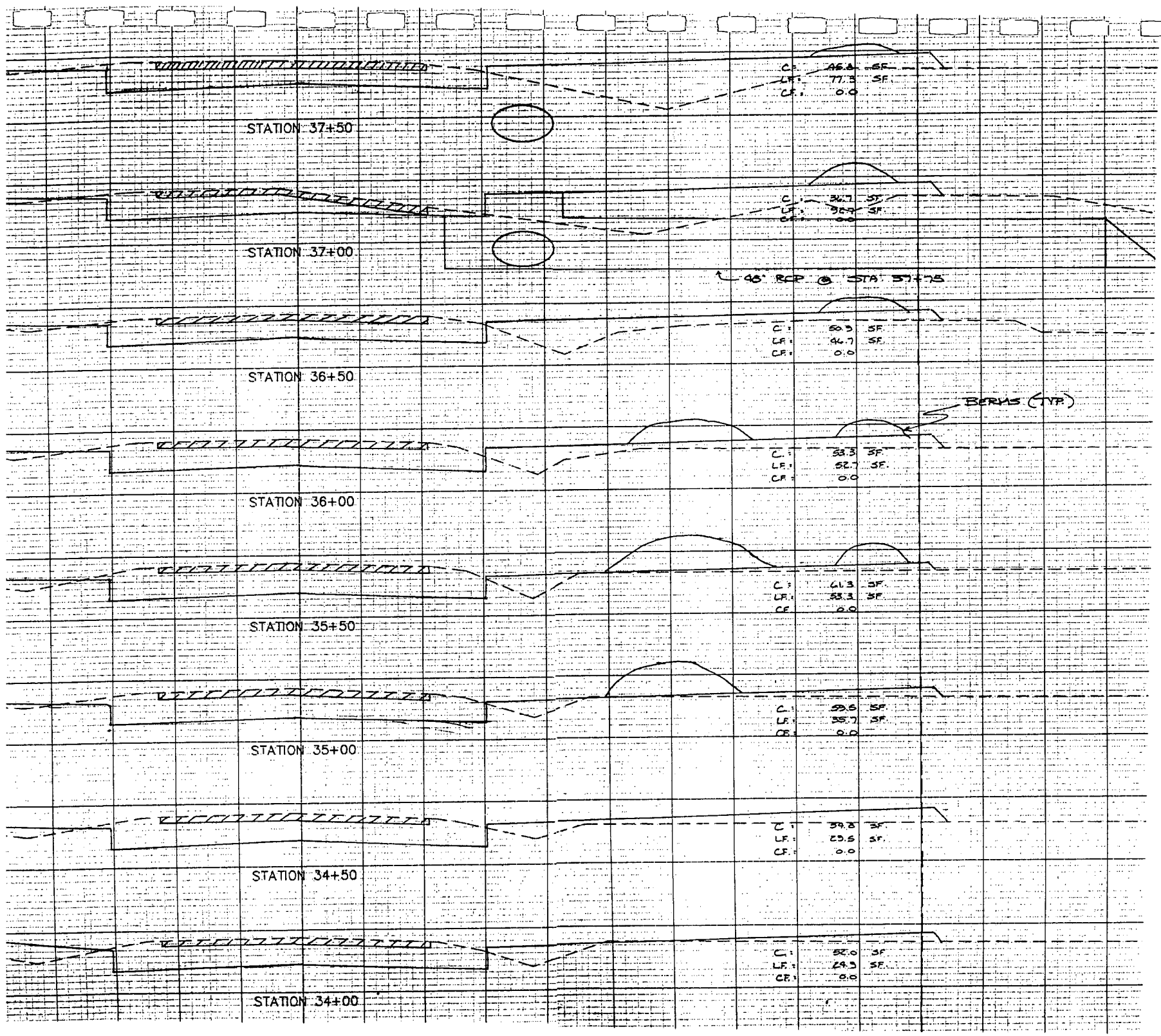
SOIL SURVEY OF SEDGWICK COUNTY KANSAS

BAY COUNTRY DRAINAGE PLAN



CITY OF WICHITA, KS PROJ. # 472-82411 CENTRAL AVE.





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CENTRAL AVE.