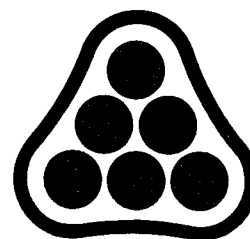


**DRAINAGE PLAN  
AND  
SUPPORTING CALCULATIONS**



**P**ROFESSIONAL  
**E**NGINEERING  
**C**ONSULTANTS  
PROFESSIONAL ASSOCIATION

**FOR  
LAKESIDE PARK  
AN ADDITION TO  
WICHITA, SEDGWICK COUNTY, KANSAS**

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

**JUNE 8, 1992**

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WICHITA, KANSAS 67202  
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Date 6/8/92 Page 1 of 2

Project Lakeside Park Add.

Item Drainage Plan.

I WEDGEWOOD ST. FLOW - 5 YR

Hydrology

Use Rational Method  $Q = cIA$

Use Light Industrial Land Use  $C_5 = 0.69$

Use  $t_c = 15 \text{ min}$   $I_5 = 4.56$

Use Area =  $\frac{1}{2} \times 530' \times 500' =$   $A = 3.04$

$$Q_5 = 0.69 \times 4.56 \times 3.04 = \underline{9.6 \text{ cfs}}$$

From chart attached,  $d = \underline{0.48'}$  OK

II WEDGEWOOD ST. FLOW - 100 - YR

Hydrology

Use Rational Method  $Q = cIA$

Use Light Industrial Land Use  $C_{100} = 0.80$

Use  $t_c = 15 \text{ min}$   $I_{100} = 7.37$

Use  $A = 3.04$

$$Q_{100} = 0.80 \times 7.37 \times 3.04 = \underline{17.9 \text{ cfs}}$$

$Q_{\text{max}} = 111.6$  OK



Date 6/8/92 Page 2 of 2

Project Lakeside Park Add.

Item Drainage Plan

II Check Culvert Size (100-yr)

Use Rational Method  $Q = CIA$

Use  $C_{100} = 0.80$

Use  $t_c = 20 \text{ min}$   $I_{100} = 6.53$

Use Area =  $900' \times 700'$  ( From Wetwood N. to 29th  
 $= 14.46 \text{ Ac.}$  From Ridge E 700' )

$$Q_{100} = 0.8 \times 6.53 \times 14.46 = 75 \text{ cfs}$$

<u>Pipe</u>	<u>HW</u>	<u>D</u>	<u>HW/D</u>	<u>Q</u>
36" CMP	3'	3'	$3/3 = 1.0$	35 cfs
48" CMP	3'	4'	$3/4 = 0.75$	50 cfs
65" x 40"	3'	3.33	$3/3.33 = 0.9$	70 cfs
72" x 44"	3'	3.67	$3/3.67 = 0.82$	80 cfs ←

Land Use or Surface Characteristics	Percent Impervious	Frequency			
		<u>2</u>	<u>5</u>	<u>10</u>	<u>100</u>
<u>Single Family (Soil Group A)</u>					
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
<u>Multi-Family (Soil Group A)</u>					
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):					
<u>Soil Group A</u>					
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
<u>Soil Group B</u>					
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
<u>Soil Group C</u>					
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

ATTACHMENT A  
DRAINAGE CRITERIA MANUAL

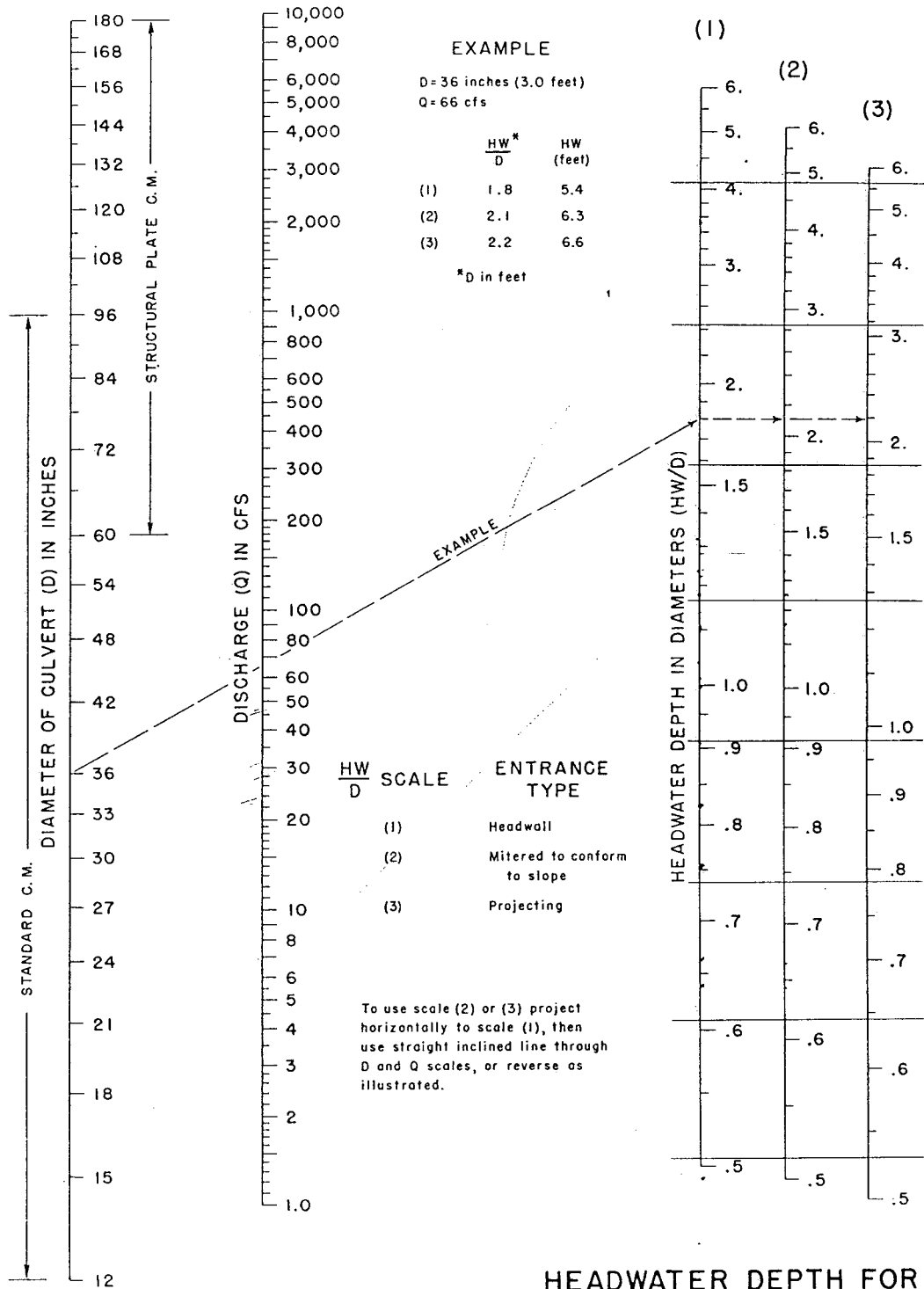
CITY OF WICHITA, KANSAS

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

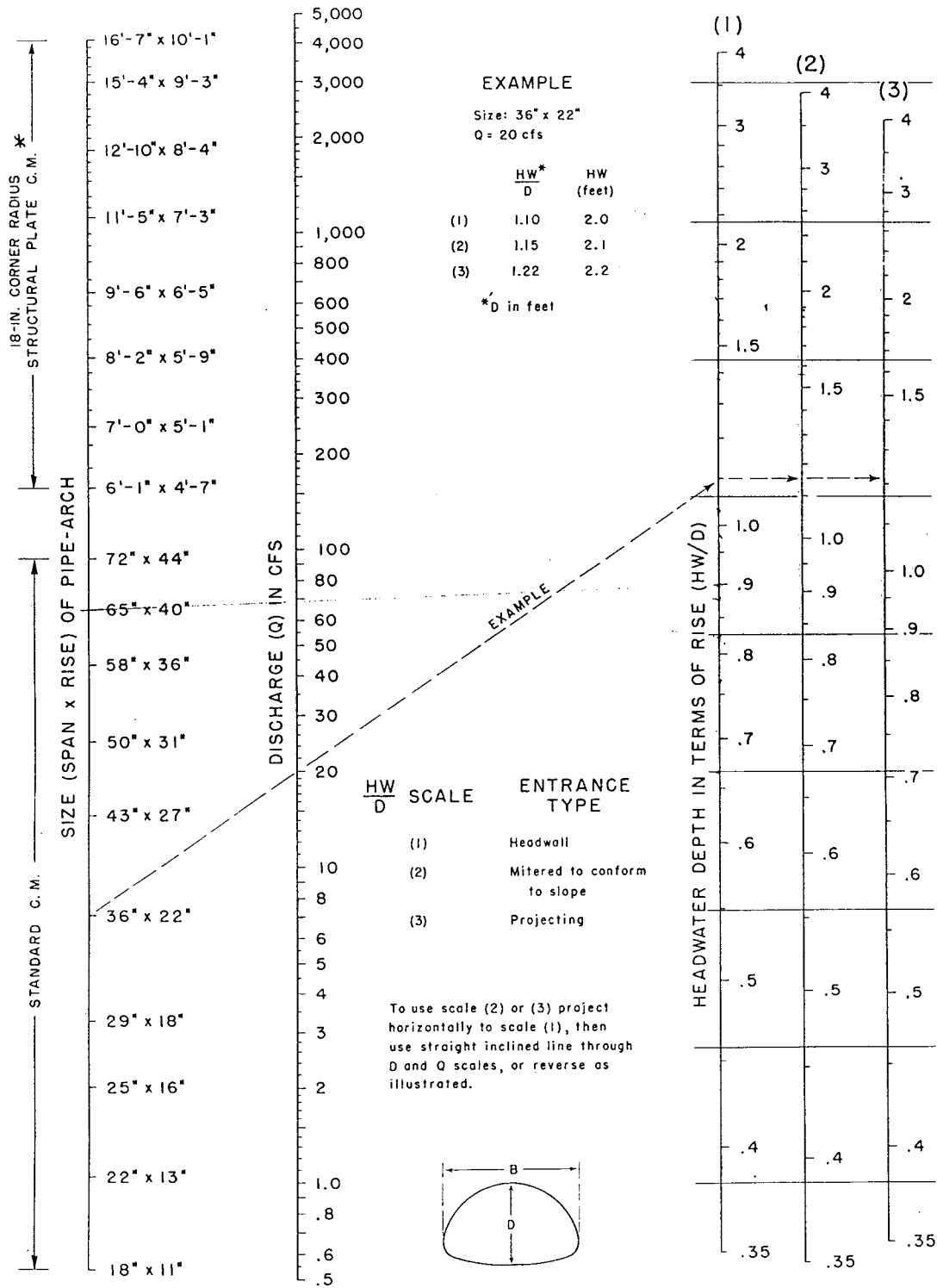
DURATION IN MINUTES	RETURN PERIODS OF						
	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	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

# CHART 5



**HEADWATER DEPTH FOR  
 C. M. PIPE CULVERTS  
 WITH INLET CONTROL**

# CHART 6



\*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR  
 C. M. PIPE-ARCH CULVERTS  
 WITH INLET CONTROL

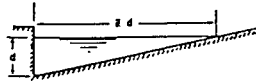
$x\text{-slope} = 3/8 \text{ "/ft} = 0.03125$

$z = 1/x\text{-slope} = 1/0.03125 = 32$

$n = 0.016$

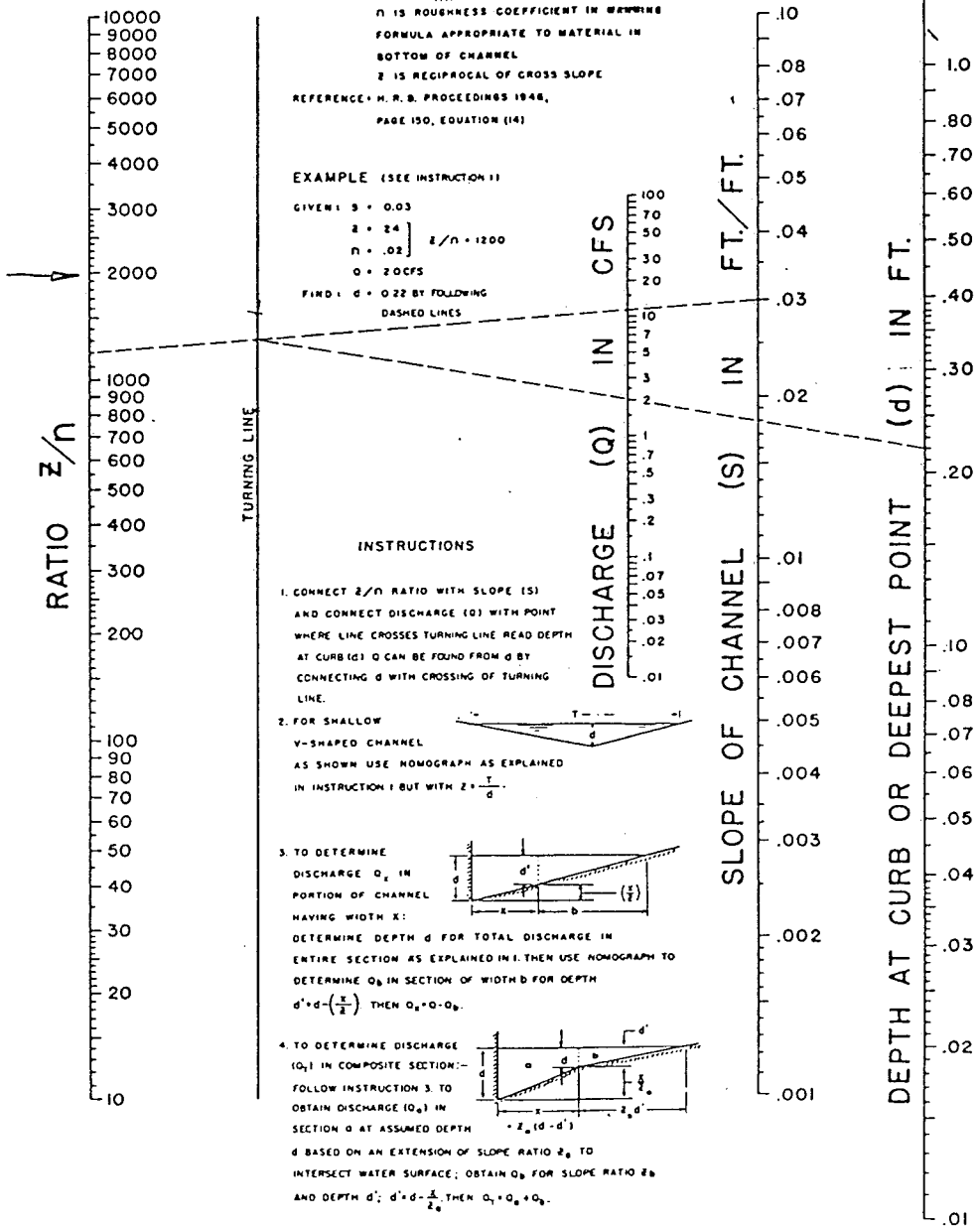
$z/n = 32/0.016 = 2000$

Chart 1



EQUATION:  $Q = 0.58 \left(\frac{z}{n}\right) s^{1/2} d^{3/2}$   
 $n$  IS ROUGHNESS COEFFICIENT IN MANNING  
 FORMULA APPROPRIATE TO MATERIAL IN  
 BOTTOM OF CHANNEL  
 $z$  IS RECIPROCAL OF CROSS SLOPE  
 REFERENCE: M. R. B. PROCEEDINGS 1948,  
 PAGE 150, EQUATION (14)

EXAMPLE (SEE INSTRUCTION 1)  
 GIVEN:  $s = 0.03$   
 $z = 32$   
 $n = .02$  }  $z/n = 1200$   
 $Q = 200 \text{ CFS}$   
 FIND:  $d = 0.22$  BY FOLLOWING  
 DASHED LINES



INSTRUCTIONS

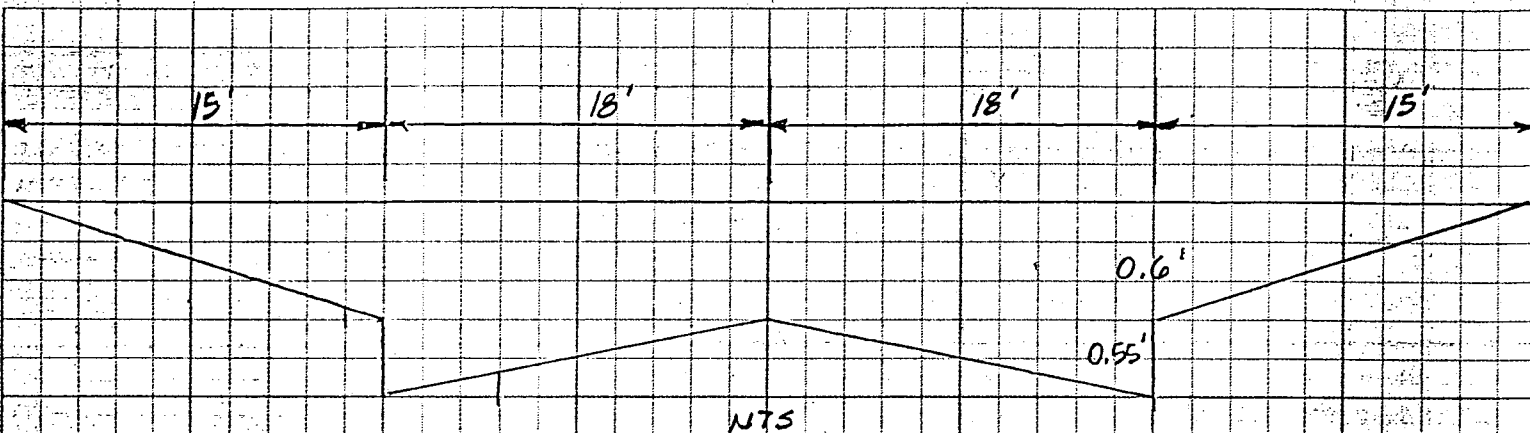
- CONNECT  $z/n$  RATIO WITH SLOPE (S) AND CONNECT DISCHARGE (Q) WITH POINT WHERE LINE CROSSES TURNING LINE READ DEPTH AT CURB (d). Q CAN BE FOUND FROM d BY CONNECTING d WITH CROSSING OF TURNING LINE.
- FOR SHALLOW V-SHAPED CHANNEL AS SHOWN USE NOMOGRAPH AS EXPLAINED IN INSTRUCTION 1 BUT WITH  $z = \frac{x}{d}$ .
- 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  $Q_x = Q - Q_b$ .
- TO DETERMINE DISCHARGE ( $Q_1$ ) IN COMPOSITE SECTION: FOLLOW INSTRUCTION 3. TO OBTAIN DISCHARGE ( $Q_2$ ) IN SECTION d AT ASSUMED DEPTH d BASED ON AN EXTENSION OF SLOPE RATIO  $z_0$  TO INTERSECT WATER SURFACE; OBTAIN  $Q_3$  FOR SLOPE RATIO  $z_b$  AND DEPTH  $d'$ ;  $d' = d - \frac{x}{z_b}$  THEN  $Q_1 = Q_2 + Q_3$ .



Date \_\_\_\_\_ Page \_\_\_\_\_ of \_\_\_\_\_

Project \_\_\_\_\_

Item Drainage Plan



66' ROW, std Ch.  
0.6' WK. Gr.

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

$$n = \frac{2(14.5 \times 0.03) + 2(3.05 \times 0.013) + 2(16 \times 0.016)}{67.1} = \frac{1.4613}{67.1} = 0.021778$$

$$A = 2\left(\frac{1}{2} \times 15 \times 0.6\right) + (0.6 \times 36) + 2\left(\frac{1}{2} \times 18 \times 0.55\right) = 40.5 \text{ SF}$$

$$p = 2(15) + 2(0.55) + 2(18) = 67.1$$

$$R = A/p = 40.5/67.1 = 0.603577$$

$$R^{2/3} = 0.714203$$

$$Q = \frac{1.486}{0.021778} \times 40.5 \times 0.714203 \times s^{1/2}$$

$$Q = 1,973.68 \text{ s}^{1/2}$$