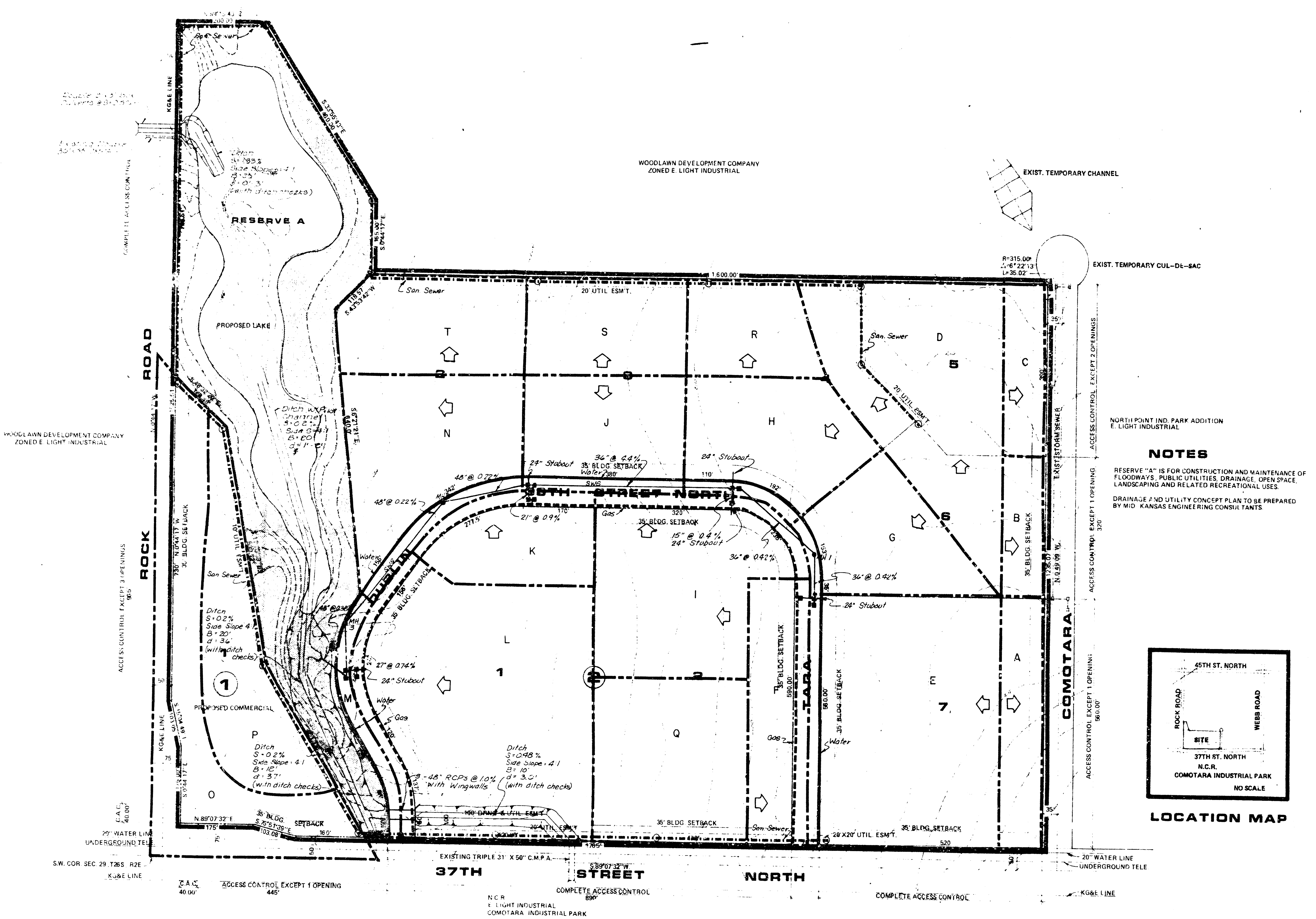

NOTES

RESERVE "A" IS FOR CONSTRUCTION AND MAINTENANCE OF FLOODWAYS, PUBLIC UTILITIES, DRAINAGE, OPEN SPACE, LANDSCAPING AND RELATED RECREATIONAL USES.

DRAINAGE AND UTILITY CONCEPT PLAN TO BE PREPARED BY MID KANSAS ENGINEERING CONSULTANTS

DRAINAGE AND UTILITY PLAN

COMOTARA HI-TECH CENTER

OWNER: WOODLAWN DEVELOPMENT COMPANY, 3500 N. ROCK ROAD, NO. 100, WICHITA, KANSAS 67226

SHEET 1

BILL G. YUNG DESIGN
8225 E. 35 TH. ST. NORTH, WICHITA, KS. 67226
316-683-5567

date NOVEMBER 16, 1984
rev. NOV 28, 1984

sheet title PRELIMINARY PLAT

project COMOTARA HI-TECH CENTER

sheet 1

	AREA (ACRES)	AREA ACCUM.	C	T_c (MIN)	I_5 (IN/HR)	I_{100} (IN/HR)	Q_5 (CFS)	Q_{100} (CFS)	PIPE SLOPE	PIPE SIZE	INLETS
A	1.26		0.70	15	5.21	8.98	4.6	7.9			
		15.76	0.70	19	4.76	8.19	52.5	90.4		Exist.	Existing
B	0.72		0.70	15	5.21	8.98	2.6	4.5			
		16.48	0.70	19	4.76	8.19	54.9	94.5		Exist.	Existing
C	0.89		0.70	15	5.21	8.98	3.2	5.5			
		17.37	0.70	19	4.76	8.19	57.9	99.5		Exist.	Existing
D	4.82		0.70	20	4.66	8.03	15.7	27.1			
E	6.01		0.70	16	5.09	8.76	21.4	36.9			[illegible]
F	1.96		0.70	15	5.21	8.98	[illegible]	12.3	0.48%	18"	[illegible]
		7.97	0.70	16	5.09	8.76	28.4	48.9	0.20%	36"	
G	2.18		0.70	15	5.21	8.98	8.0	13.7			
		10.15	0.70	18	4.86	8.37	34.5	59.5			
H	2.53		0.70	15	5.21	8.98	9.2	15.9			[illegible]
		12.68	0.70	19	4.75	8.19	42.2	72.7	0.44%	36"	
I	3.90		0.70	15	5.21	8.98	14.2	24.5			[illegible]
		16.58	0.70	20	4.66	8.03	54.1	93.2			
J	2.23		0.70	15	5.21	8.98	8.1	14.0			[illegible]
		18.81	0.70	21	4.57	7.88	60.2	103.8	0.22%	48"	
K	1.75		0.70	15	5.21	8.98	6.4	11.0			[illegible]
		20.56	0.70	23	4.41	7.60	63.5	109.4	0.22%	48"	
L	7.22		0.70	16	5.09	8.76	25.7	44.3			[illegible]
		27.78	0.70	25	4.27	7.36	83.0	143.1			
M	0.48		0.35	15	5.21	8.98	[illegible]	4.1			[illegible]
		28.26	0.71	26	4.21	7.25	84.5	145.5	0.38%	48"	
N	3.37		0.70	15	5.21	8.98	12.3	20.5		Not Req'd	
O	4.50		0.70	15	5.21	8.98	16.4	28.3		Not Req'd	
P	4.58		0.70	15	5.21	8.98	16.7	28.8		Not Req'd	
Q	3.20		0.70	15	5.21	8.98	[illegible]	20.1		Not Req'd	
R	1.52		0.70	15	5.21	8.98	5.5	9.5		Not Req'd	
S	1.98		0.70	15	5.21	8.98	7.2	12.4		Not Req'd	
T	2.32		0.70	15	5.21	8.98	8.5	14.6		Not Req'd	
Reserve A	12.67		0.70	15	5.21	8.98	46.2	79.6		Not Req'd	
Ditch in Reserve A	Ditch will nee[illegible]ch checks to control erosion.										
Initial	13.92		0.70	18	4.86	8.37	47.4	81.6			
At Culvert Under Dublin		81.90	0.70	37	3.33	5.76	190.9	330.2			
Final		110.16	0.70	39	3.[illegible]9	5.53	246.3	426.4			
Total Acreage of Runoff to Lake	145.18		0.70	45	2.86	4.95	290.7	503.3			

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Culverts - 1

Determine max Q through the 4 - 31"x50" CMPA's

Approx. Design Data

L=110'
S_o=0.004 ft/ft
Allowable HW= 4'

CMPA w/ square-edge [illegible]
K_e=0.5
Max rise = 31" = 2.5833'

A. For Inlet Control

$\frac{HW}{D} = \frac{4}{2.5833} = 1.55$ from Chart 6 for 1 CMPA, Q = 65 cfs

Total Q = 4 x 65 = 260 cfs

B For Outlet Control

$HW=4' = H + h_o - LS_o \Longrightarrow H + h_o = HW + 4 + 110(0.004) = 4.44'$

$H = 4.44 - 2.5833 = 1.8567'$ from Chart 12, Q = 46 cfs

Total Q = 4 x 46 = 184 cfs

Design Ditch based on Q = 260 cfs. Present ditch is approx 5' deep. ∴ set d=4', [illegible] = 0.0067 ft/ft

Flow from Area = 3.2(.7)(8.98) = 20.1 cfs

Ditch: B=6', d=4', S=0.002'/1 & Side Slope 4:1

Initial ℄ Elev of Ditch = 205 - 5 = 201

℄ Elev @ R.O.W of Dublin = 201 - 0.002(415) = 200.17

To get ditch 5' in ground, ℄ Elev @ R.O.W of Dublin must = 202-5 = 197.0. Then S_{must} = [illegible] = 0.00[illegible]

With 2 ditch checks, S = [illegible] = .0048

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Culverts - 2

Try B=8', d=3', Side slopes 4:1 - Q=264.3 cfs N.G.

Try B=10', d=3', " " 4:1 Q=297.8 cfs > 280 cfs OK

Ditch configuration

d=3' D=4.0' B=10' Width = 38' 42'

Initial ℄ Elev of Ditch = 206 - 4.0 = 202.0 - go with the existing fl of [illegible] CMPA?

℄ Elev @ R.O.W of Dublin = 202.0 - 0.01(415) = 197.85

Approx. depth [illegible] Dublin = 205 - 197.85 = 7.15'

Before the culvert under Dublin can be designed, the ℄ of the ditch to the lake must be determine. To determine this ℄, the box culvert @ Sta 12+50, 37th St N. must be designed. ℄ Elev @ outlet of RCBC will be approx. 196.75. Assuming a slope of 0.2% on the ditch to the lake, the ℄ Elev of the ditch @ the outlet of the [illegible] culvert would be 196.75 - .002(50) = 196.65

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Culverts - 3

A. For Inlet Control

RCP	Try 2 - 36" Chart 2	$\frac{HW}{D} = \frac{4}{3} = 1.33$	Q = 50 cfs x 2 = 100 cfs	N.G.
	Try. 3 - 42"	$\frac{HW}{D} = \frac{48}{42} = 1.14$	Q = 60 cfs x 3 = 180 cfs	N.G.
	Try 3 - 48"	$\frac{HW}{D} = \frac{48}{48} = 1.0$	Q = 80 cfs x 3 = 240 cfs	N.G.
HERCP	Try 3 - 38"x60" Chart 3	$\frac{HW}{D} = 1.26$	Q = 93 cfs x 3 = 279 cfs	OK
CMP	Try 3 - 48" Chart 5	$\frac{HW}{D} = 1.0$	Q = 72 x 3 = 216 cfs	N.G.
CMPA	Try 3 - 36"x58" Chart 6	$\frac{HW}{D} = 1.33$	Q = 70 x 3 = 210 cfs	N.G

B. For Outlet Control

Try 3 - 48" RCP's Q = 93 cfs H = 1.55 (Chart 9)

d_c = 2.9' (Chart 16) TW = 4' - (197.19 - 196.65) = 3.46'

$\frac{d_c+D}{2} = \frac{2.9+4}{2} = 3.45'$ $HW = H + h_o - LS_o = 1.55 + 3.45 - (66).01 = 4.34' > 4$

Try 3 - 38" x 60" HERCP Q = 94 cfs H = 1.48' (Chart 10)

d_c = 2.46 (Chart 17) $\frac{d_c+D}{2} = \frac{2.46+2.17}{2} = 2.81$ TW = 3.46'

HW = 1.48 + 3.46 - 66(.01) = 4.28' ≯ 4

An HW of 4' would put the water surface @ 197.85 + 4 = 201.85.

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Culverts - 4

A. For Inlet Control

$\frac{HW}{D} = \frac{4.65}{4} = 1.16$ Chart 2 Q = 95 cfs x 3 = 285 cfs OK

$\frac{HW}{D} = \frac{5}{4} = 1.25$ Q = 100 cfs x 3 = 300 cfs OK

B. For Outlet Control

3 - 48" RCP Q = 95 cfs H = 1.55' TW = 3.46

d_c = 2.95' (Chart 9, Chart 16) $\frac{d_c+D}{2} = \frac{2.95+4}{2} = 3.48$ HW = 1.55 + 3.48 - .66 = 4.37' < 4.65' O

Ditch To Lake

Initial Q = 81.2 cfs Configuration of ditch would initially S=0.2%, Side Slope 4:1, Total Depth = 204.5 - 197.1 = 7.4' With 4:1 side Slope, the side slopes of ditch would be 30'. With B = 8', d = 2.25' Q = 92.6 cfs

Total width of ditch would be (30x2)+8 = 68' < 75' easemt.

@ Dublin culvert Q_{100} = 330.2 cfs

S=0.2% Side Slope = 4:1, B=12', d=3.7' Q=331.2 cfs > 330.2 cfs OK

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Culverts - 5

Culvert under Rock Road

Proposed top of curb for Rock Rd @ proposed culvert, Elev = 193.18

Top of Culvert must ∴ be @ 193.18 - 2' = 191.18

Per KHE, assume Lake is a ditch, rather than detention basin. ∴ Determine Time of Travel, T_t, to culvert from 48" RCP End Sect.

Approx S = 0.5%, approx side slopes 18:1; approx B = 20'

approx d = 2.25' Q = 498 cfs

Area of channel X-section = 136 sq ft, $V = \frac{498}{136} = 3.7$ fps

$T_t = 1300\ ft \div [3.7\ fps \times \frac{60\ sec}{1\ min}] = 5.9$ min

T_c = 6 + 39 = 45 min Q_{100} = 505 cfs

To minimize the depth of the ℄ @ Rock Rd make culvert height 3' max. ∴ approx. ℄ elev of culvert = 191.18 - 3 - 1 = 187.18 (approx. top thickness)

A. For Inlet Control

Try two 8' x 3' RCBC's w/ 45° Wingwalls Chart 1

$Q_{per\ box} = \frac{505}{2} = 252.5$ cfs $\frac{Q}{B} = \frac{252.5}{8} = 31.6$. From Chart 1,

$\frac{HW}{D}$ = 2.05. HW = 2.05(3) = 6.05' 187.18 + 6.05 = 193.23 > 193.18 N.

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Culverts - 6

Based on d_c, $HW = H - h_o - LS_o$ = .62 + 3 - [illegible](.005) = 3.57 > 5.4 OK

Max HW = 5.4' for inlet control ∴ HW must be less than that to keep culvert under inlet control. This makes

$TW < HW - H + LS_o$ = 5.4 - .62 + .55 = 5.25'

In order for flow to continue west of Rock Rd a ditch will be required. Per map, the nearest 185 contour is approximately 350' on west. The slope of the ditch, $S = \frac{187-185}{350}$ = .0057 Use 0.505%

Ave. Elev in this area = 190 ∴ depth of ditch ≈ 3'

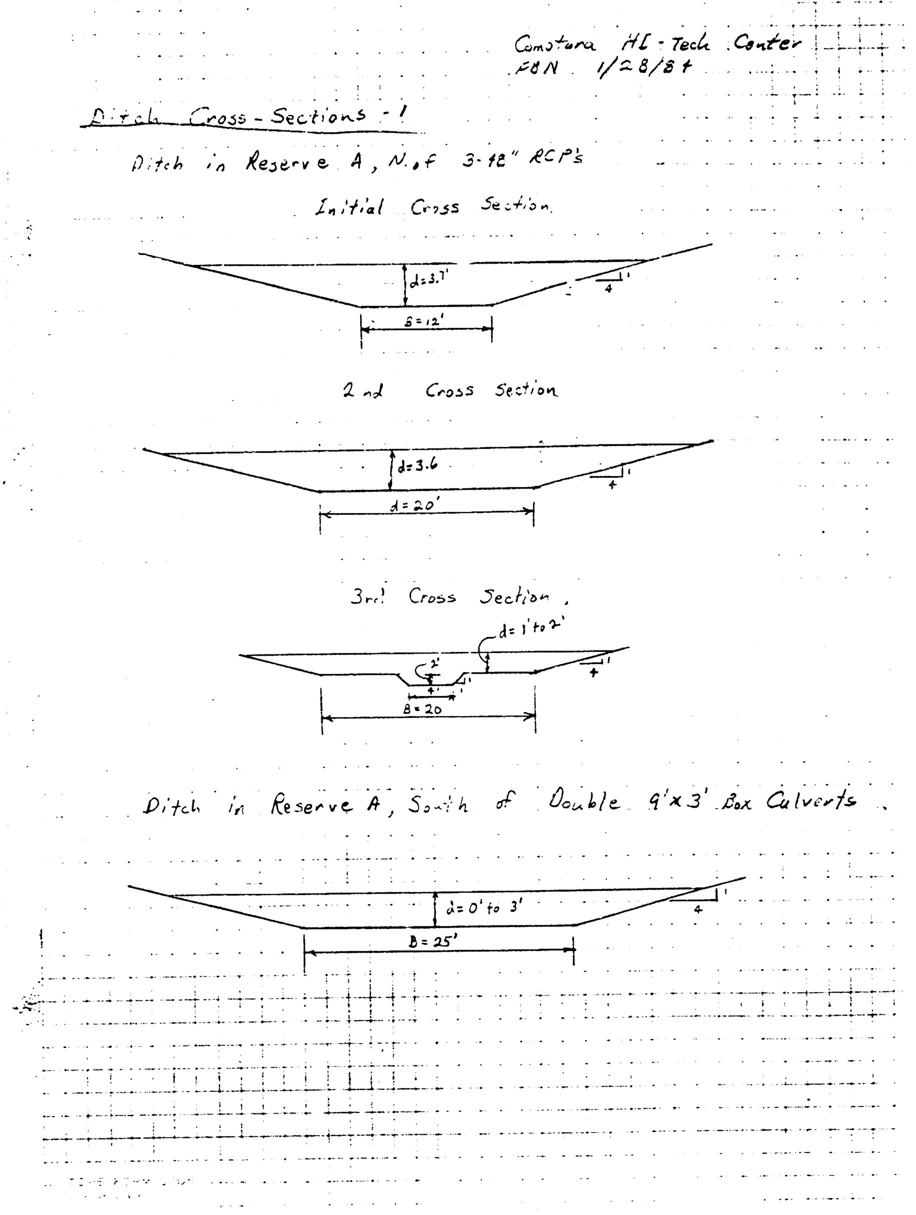
Try B = 20', d = 3.0', Side Slopes = 4:1, Q = 479.5 < 505 cfs

Try B = 25', d = 2.5', " " ", Q = 405.5 cfs < 505 cfs

Try B = 25', d = 2.6', Q = 435.[illegible] <

Try B = 26', d = 2.8', Q = 5[illegible] > 505 cfs OK

TW = 2.8' < 5.27' OK


Ditch Cross-Sections - 1
Ditch in Reserve A, N. of 3-12" RCP's
Initial Cross Section
2nd Cross Section
3rd Cross Section
Ditch in Reserve A, South of Double 4'x3' Box Culverts

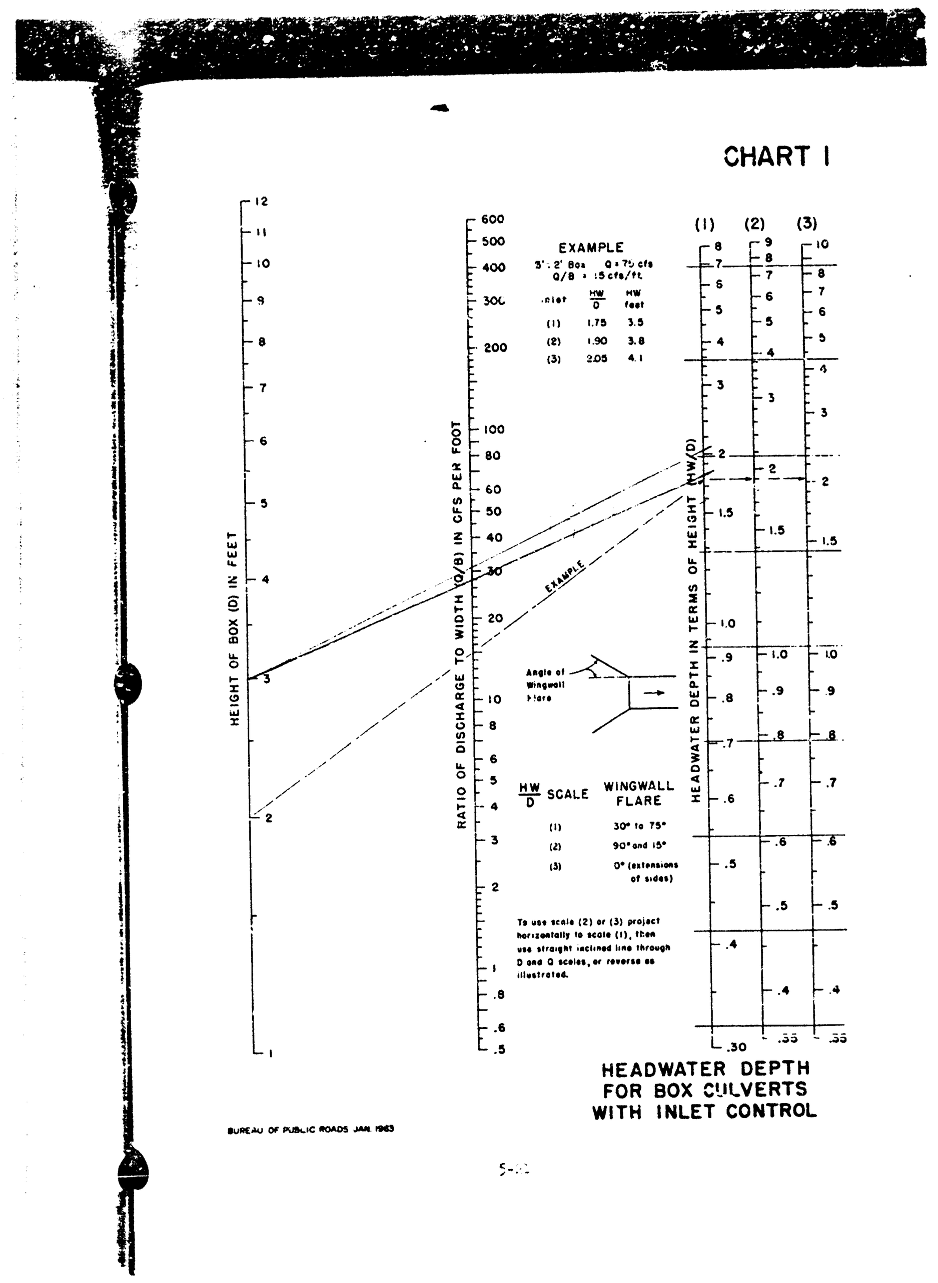


CHART 1
HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL
BUREAU OF PUBLIC ROADS JAN. 1963

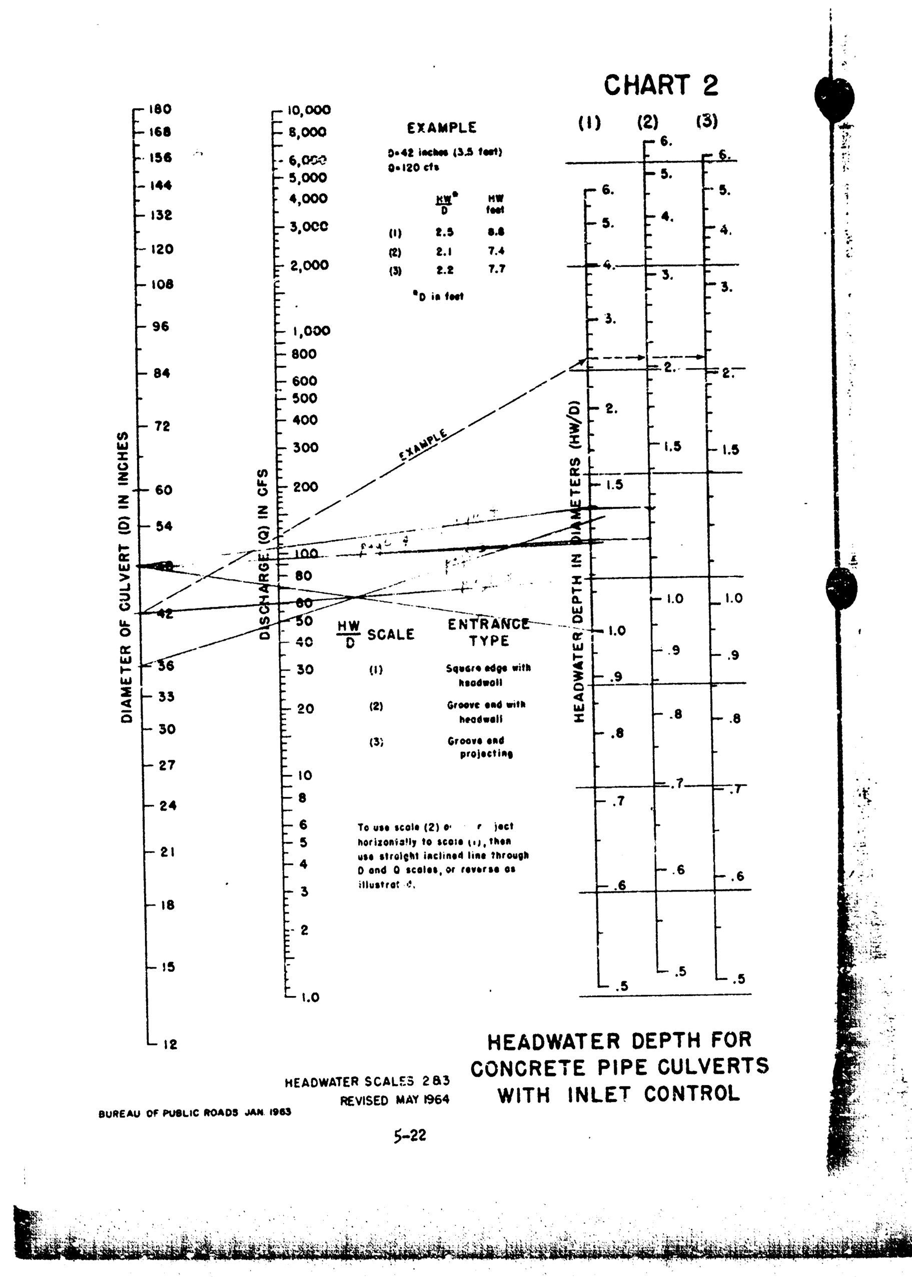


CHART 2
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL
HEADWATER SCALES 2&3 REVISED MAY 1964
BUREAU OF PUBLIC ROADS JAN. 1963
5-22

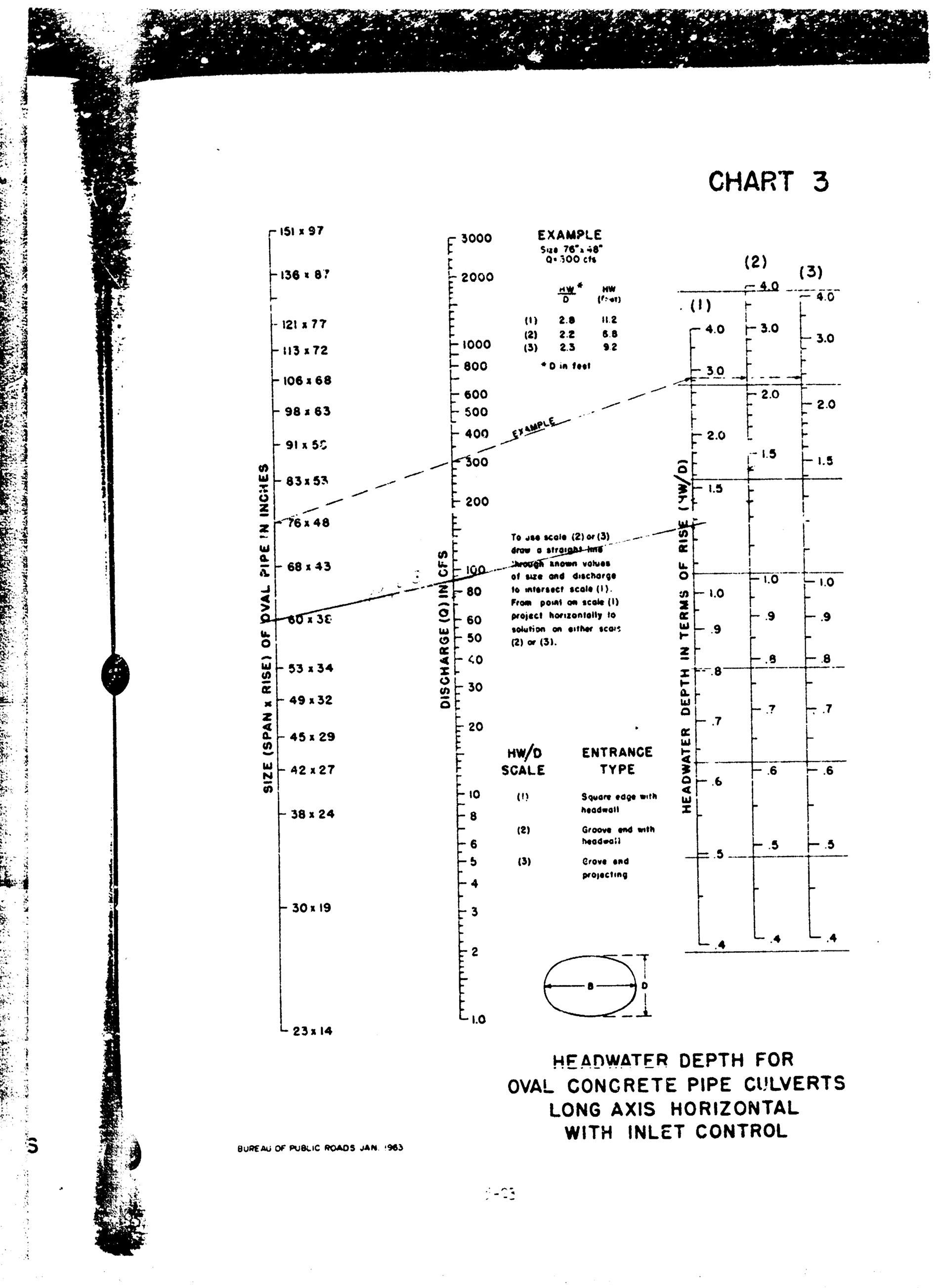


CHART 3
HEADWATER DEPTH FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS HORIZONTAL WITH INLET CONTROL

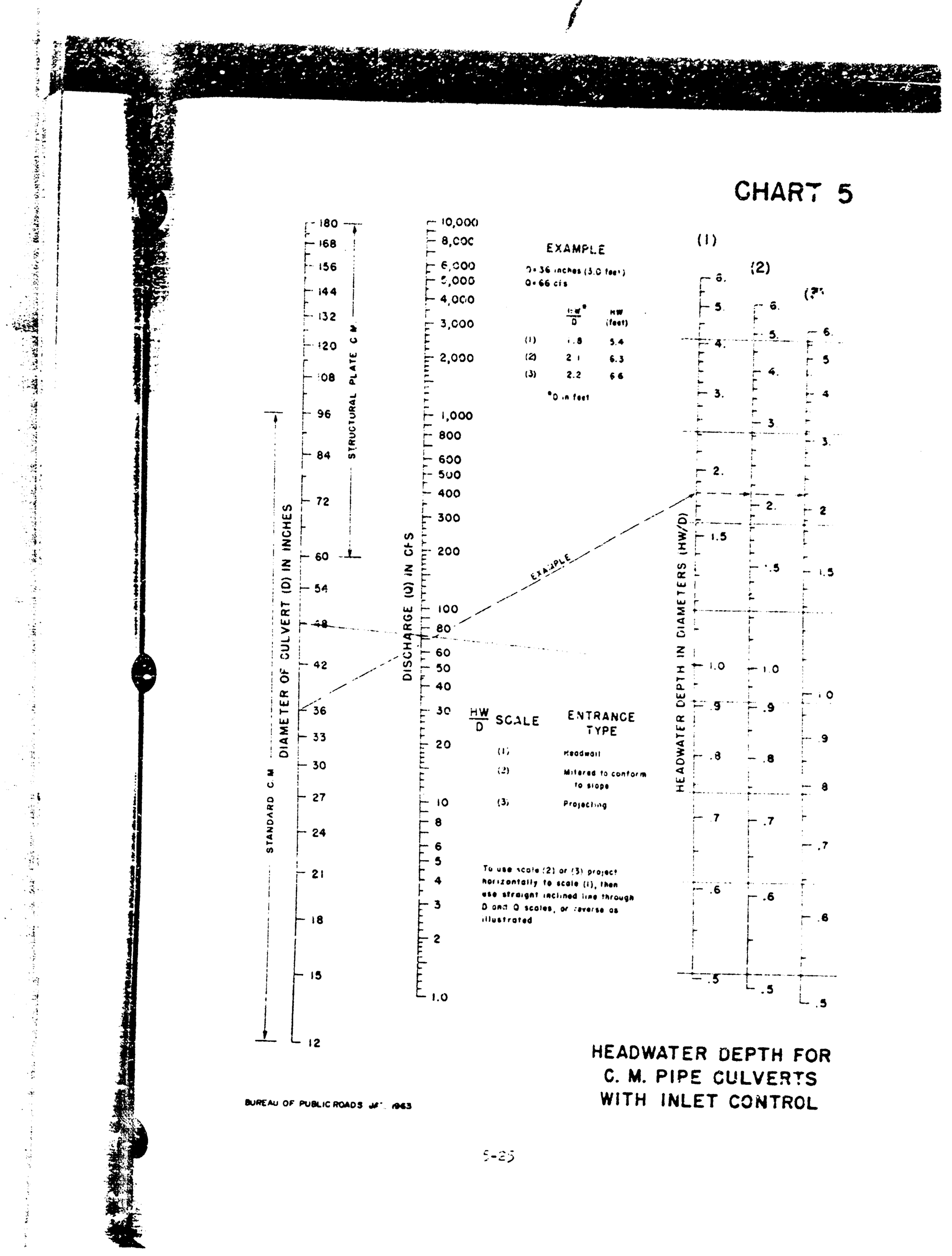


CHART 5
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

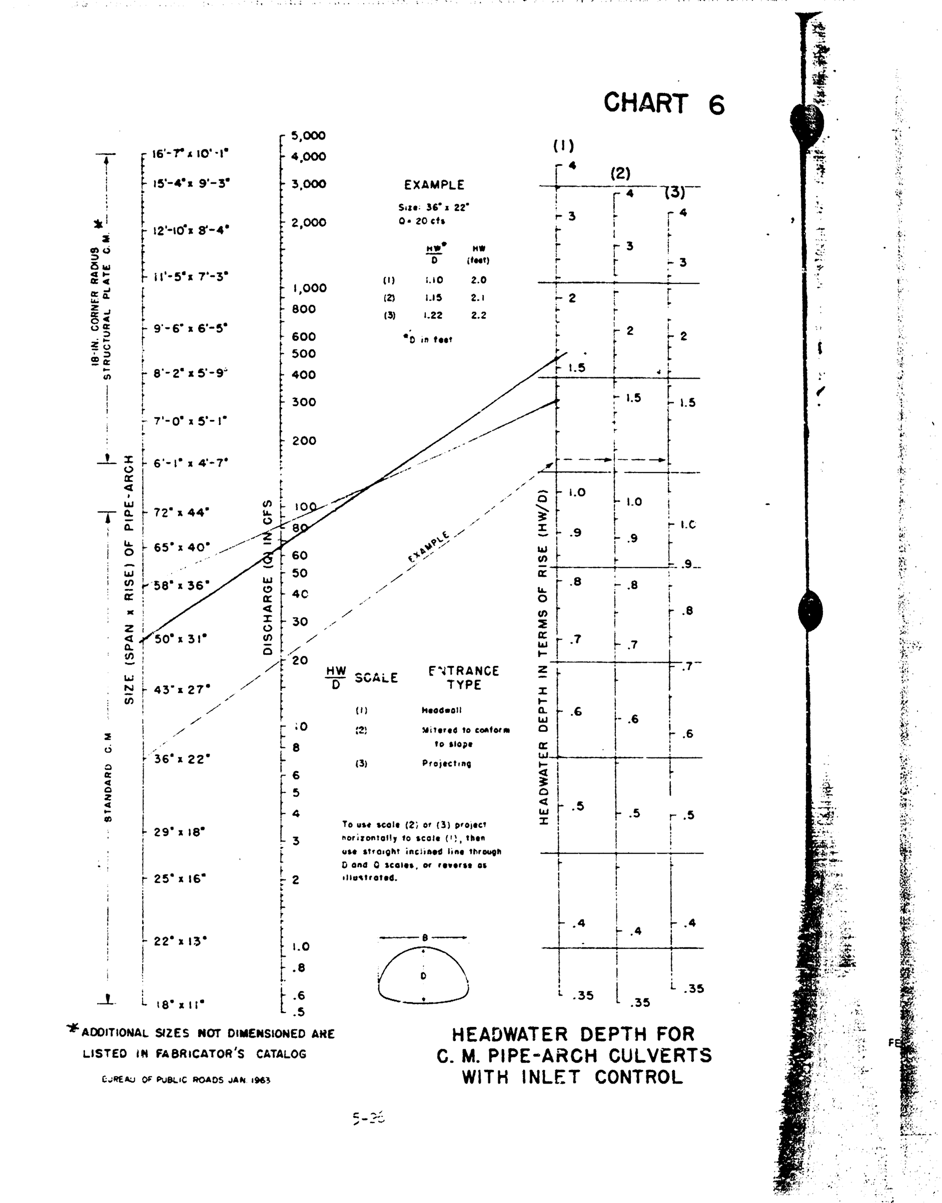


CHART 6
*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG
HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL
BUREAU OF PUBLIC ROADS JAN. 1963

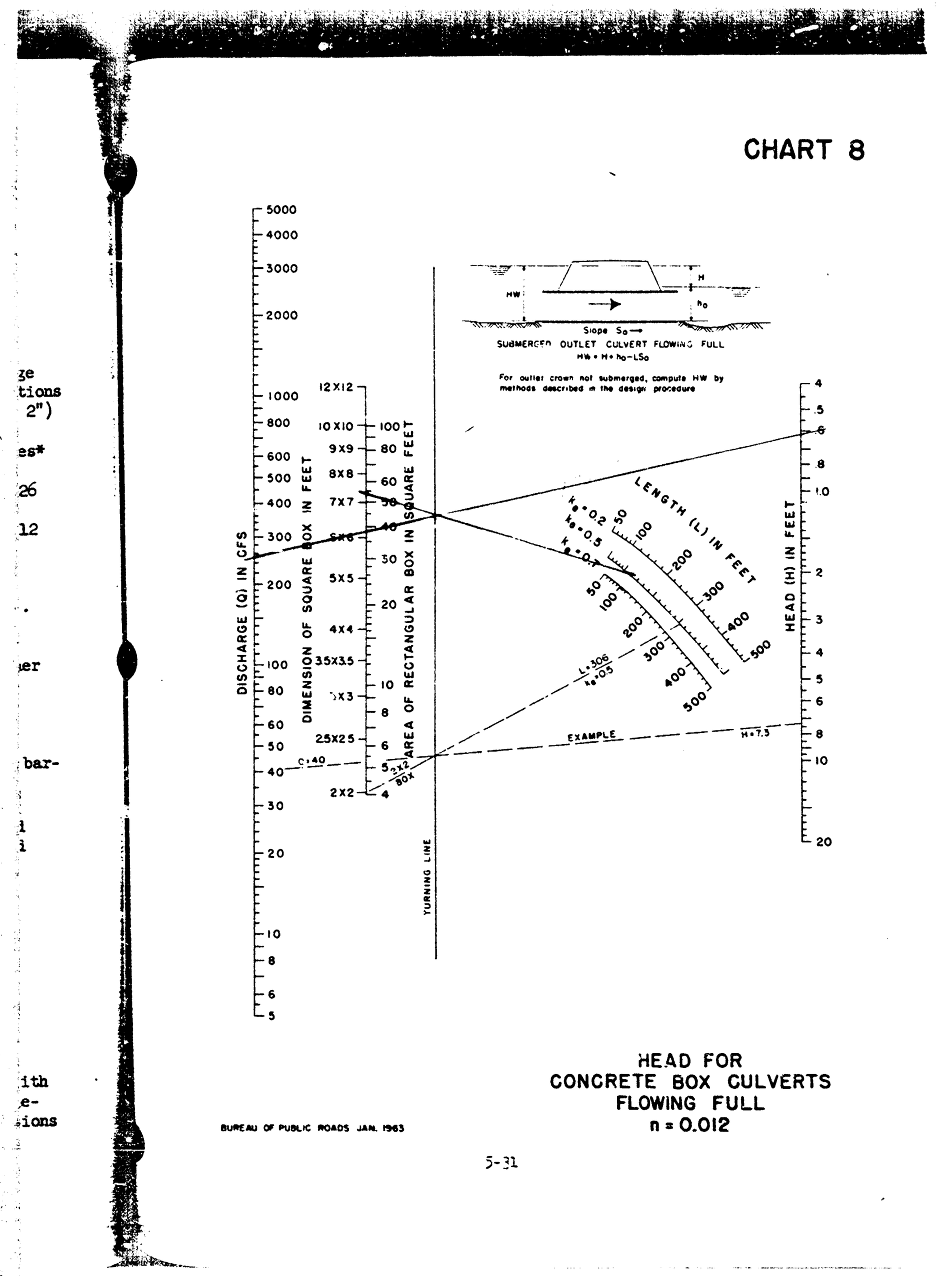


CHART 8
HEAD FOR CONCRETE BOX CULVERTS FLOWING FULL
n = 0.012
BUREAU OF PUBLIC ROADS JAN. 1963

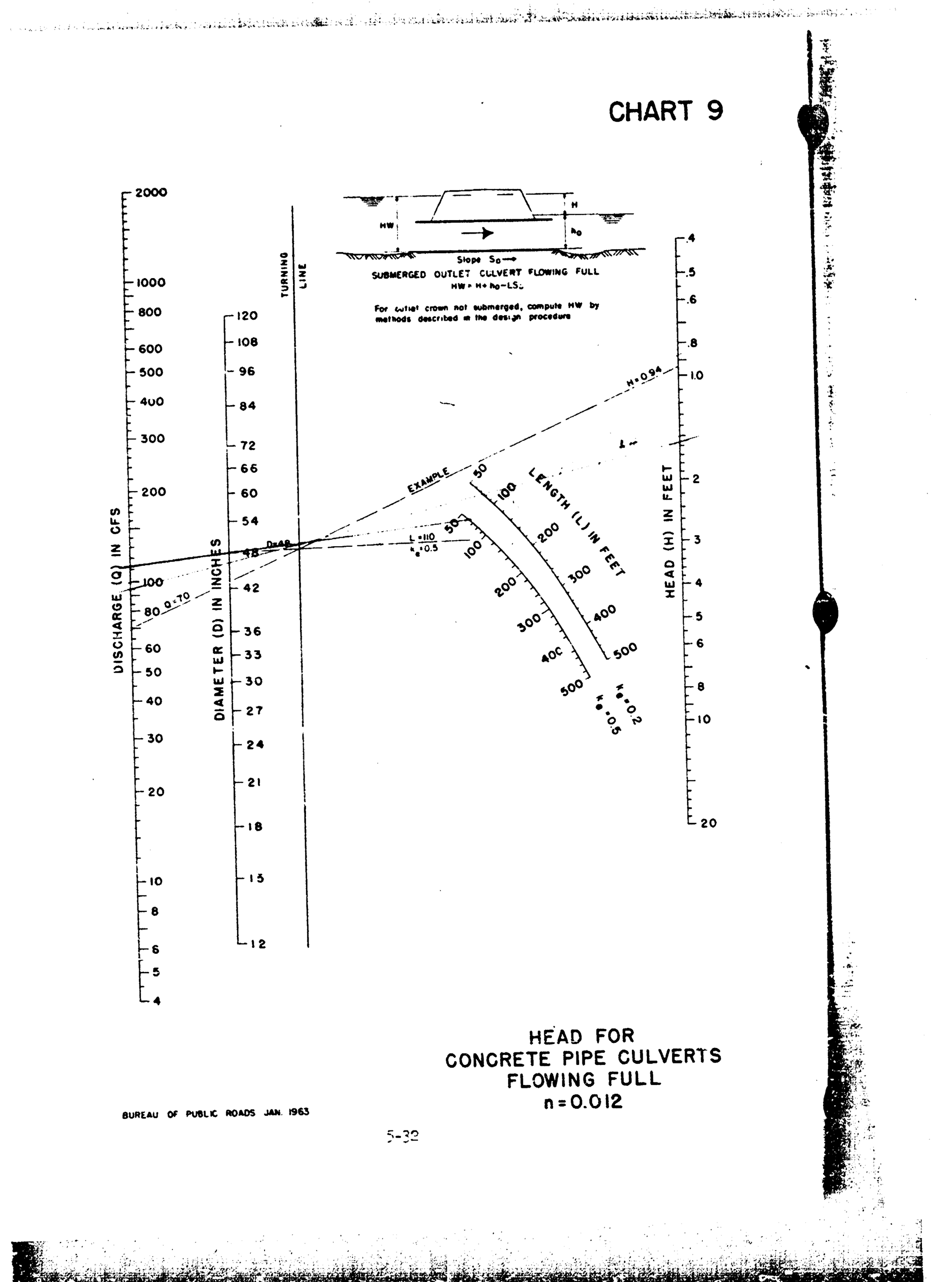


CHART 9
HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL
n = 0.012
BUREAU OF PUBLIC ROADS JAN. 1963

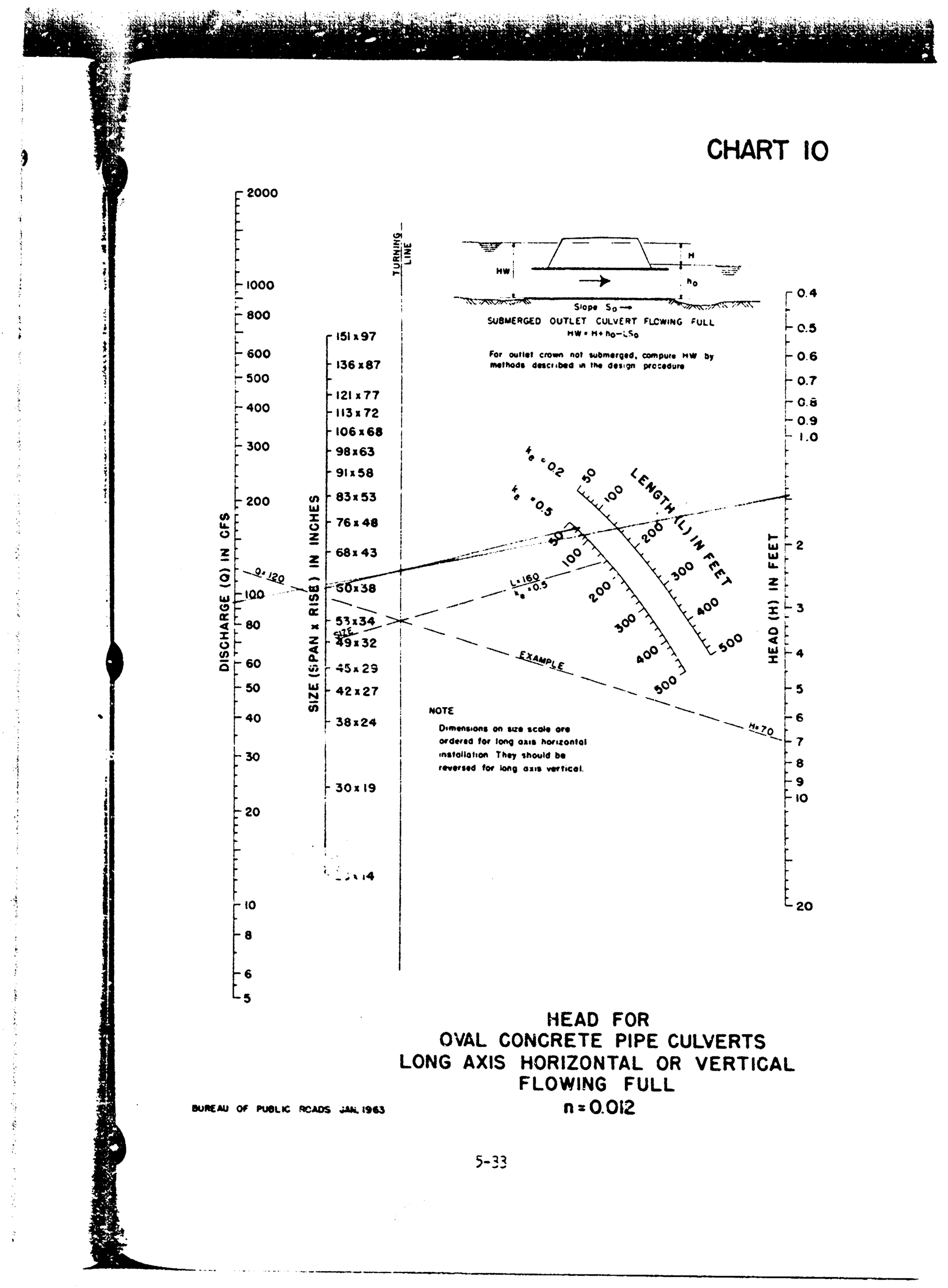


CHART 10
HEAD FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS HORIZONTAL OR VERTICAL FLOWING FULL
n = 0.012
BUREAU OF PUBLIC ROADS JAN. 1963

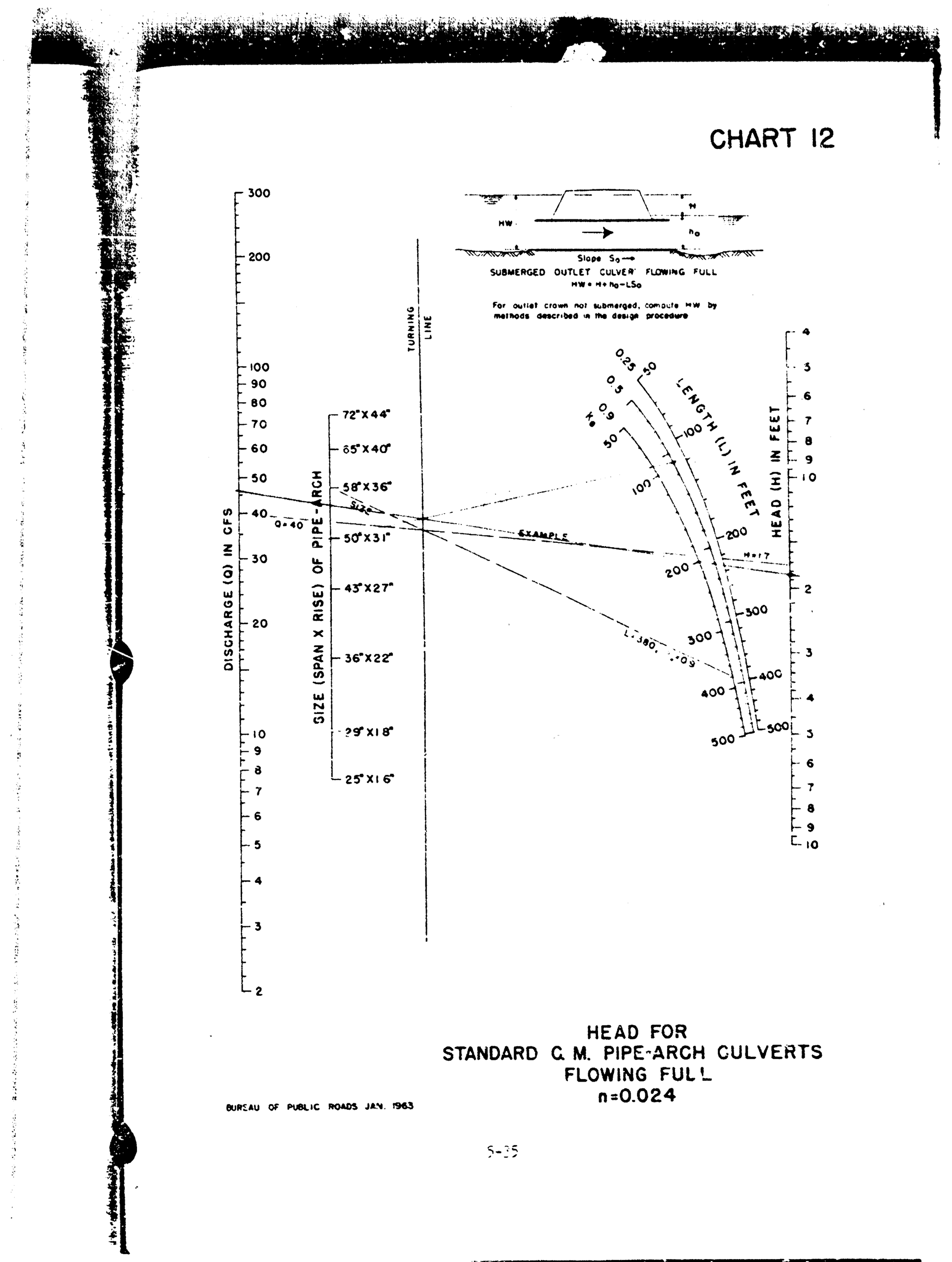


CHART 12
HEAD FOR STANDARD C. M. PIPE-ARCH CULVERTS FLOWING FULL
n = 0.024
BUREAU OF PUBLIC ROADS JAN. 1963

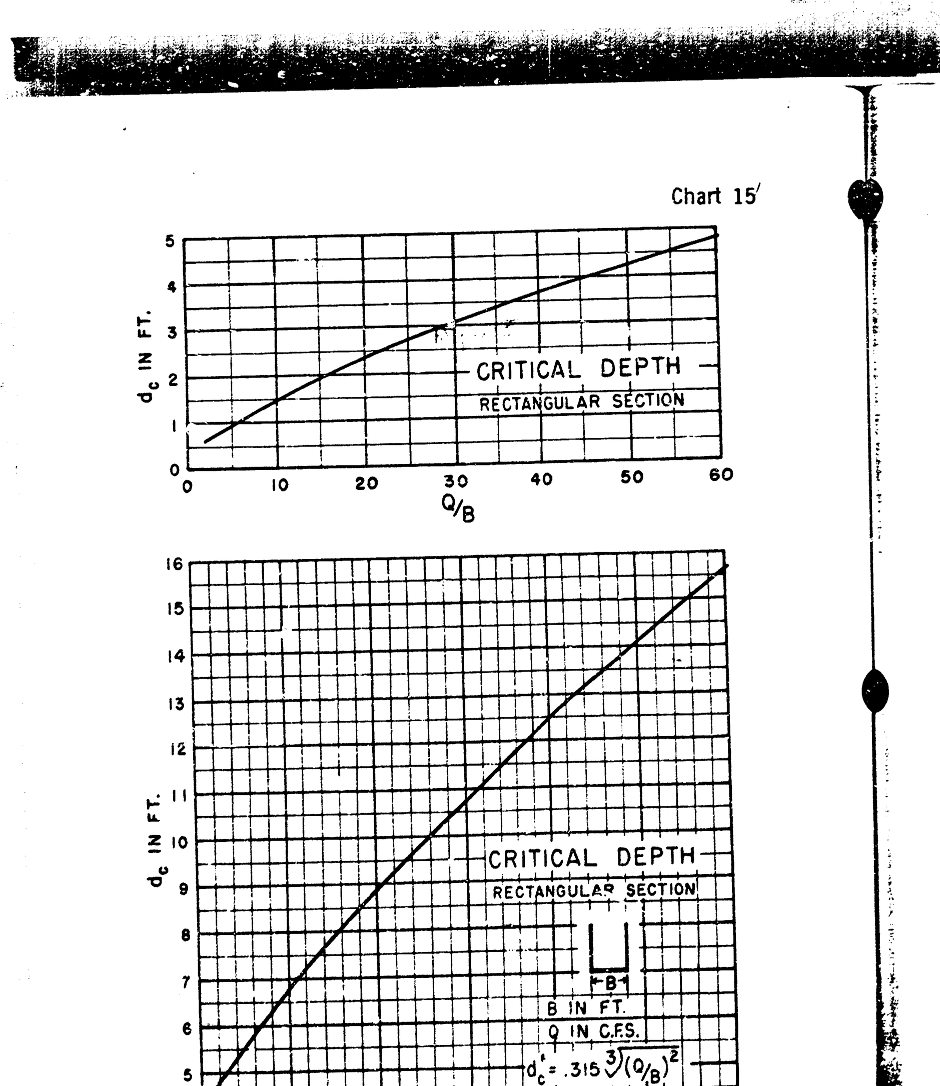


Chart 15
CRITICAL DEPTH
RECTANGULAR SECTION
Q/B
d_c IN FT.
B IN FT.
Q IN C.F.S.
$d_c = .315\sqrt[3]{(Q/B)^2}$

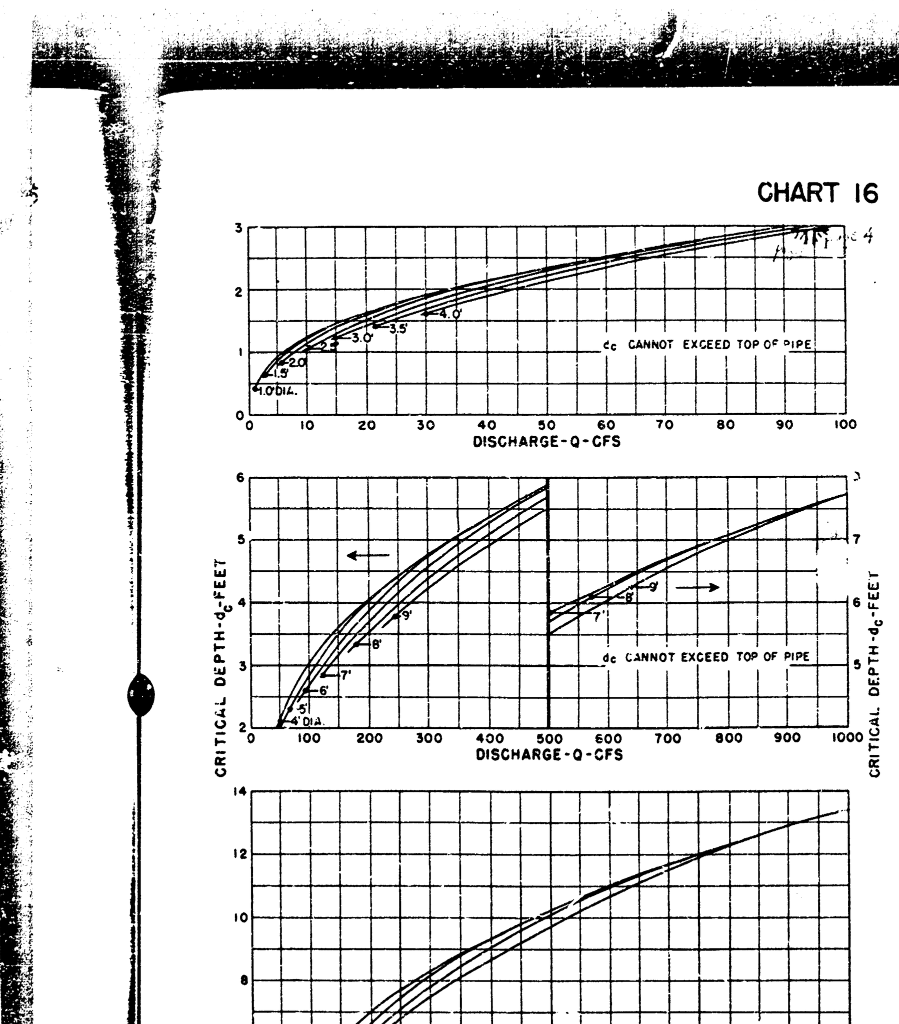


CHART 16
DISCHARGE-Q-CFS
d_c CANNOT EXCEED TOP OF PIPE
CRITICAL DEPTH-d_c-FEET

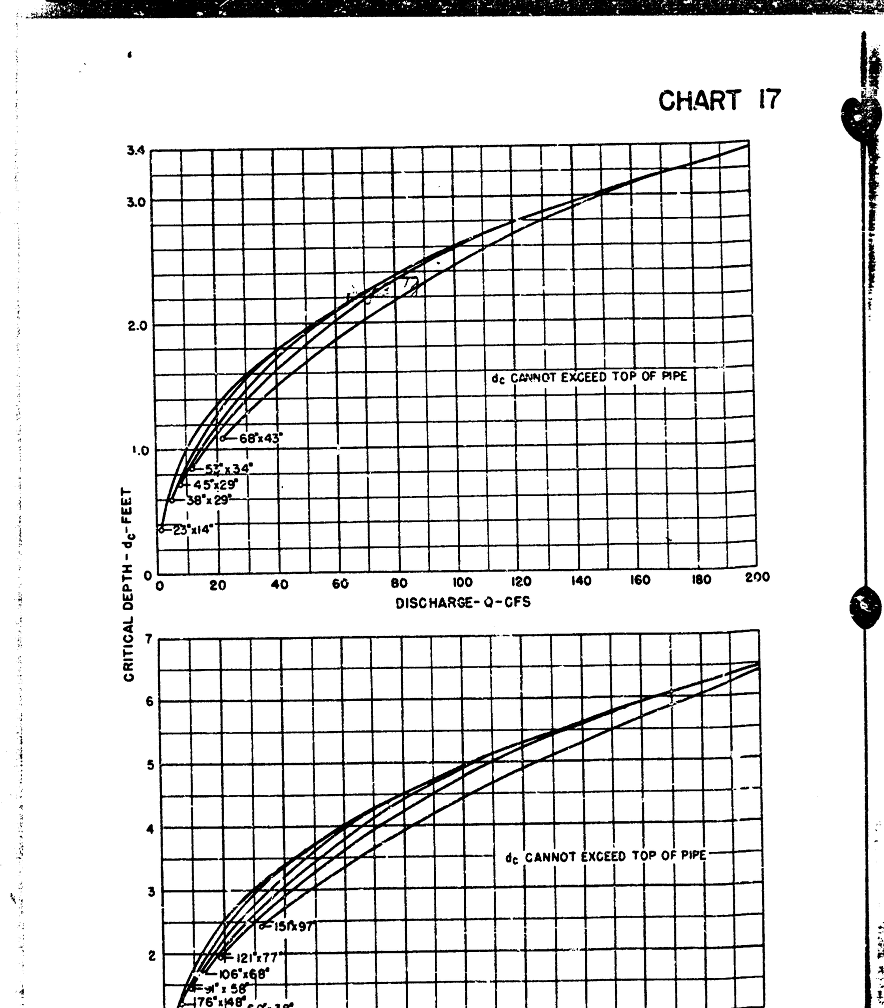


CHART 17
DISCHARGE-Q-CFS
d_c CANNOT EXCEED TOP OF PIPE
CRITICAL DEPTH-d_c-FEET