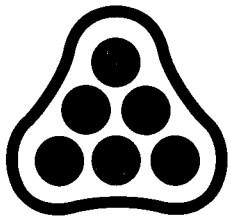

PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

REFLECTION RIDGE 9TH ADDITION

TO WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

ENGINEERS

WICHITA, KANSAS

NOVEMBER 23, 1992

303 S. TOPEKA
WICHITA, KANSAS 67202
(316) 262-2691
FAX (316) 262-3003

MEMO

PROFESSIONAL ENGINEERING CONSULTANTS
PROFESSIONAL ASSOCIATION
303 S. TOPEKA
WICHITA, KANSAS
ZIP CODE / 67202

TO: Michael E. Lindebak, P.E.
455 N. Main - 7th Floor
Wichita, KS 67220
ATTN: Ms. Vicky, Huang, P.E.

PROJECT NO. 36-92532-2273
PROJECT: Reflection Ridge
Drainage Plan
DATE: November 23, 1992

COPIES TO:
Marvin Schellenberg

FROM: Michael W. Berry, P.E. MWB
REFERENCE: Drainage Plan Computations

PLEASE ADVISE IMMEDIATELY OF ANY MISCONCEPTIONS OR OMISSIONS YOU BELIEVE TO BE CONTAINED HEREIN.

Attached hereto are the computations for the referenced project.

The publication Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation, City of Wichita, as revised 7/1/87, was used as the guideline for the hydrologic and hydraulic computations. This publication is hereinafter referred to as the "Design Manual."

Manual #1, as referenced herein, refers to Design of Urban Highway Drainage - The State of the Art, by Reitz & Jens, Inc., April 1980. Manual #2 refers to Drainage of Highway Pavements, Hydraulic Engineering Circular #12, by Tye Engineering, Inc., March 1984.

The analysis made herein is based on the available site data which includes a 1992 topographic survey map, project plans for various improvements on adjacent lands, and the Drainage Plan for Reflection Ridge Addition and Reflection Ridge 7th Addition.

HYDROLOGIC ANALYSIS FOR STORM WATER SEWERS

For storm sewer design, the Rational Method was used for hydrologic analysis in accordance with the Design Manual. Runoff coefficients were based on the table provided in Attachment D of the Design Manual. The Rational Method assumes uniformly distributed rainfall, both temporally and spatially.

For this development, a uniform assumption of the minimum time of concentration value of 15 minutes was appropriate. For golf course areas, the time of concentration was estimated using flow velocities of 1 foot/second and were found also to yield time of concentration of approximately 15 minutes.

Travel time for flow-through defined channels, pipes, etc., for these basins was estimated on the basis of Manning's Equation.

HYDRAULIC ANALYSIS FOR STORM WATER SEWERS

For each inlet, street flooding and inlet capacity was checked for the minor storm. Conveyance in the street was based on the modified Manning Equation:

$$Q = 0.56\ (S_x)^{5/3}(T)^{8/3}\ S\ /n \quad \text{(Eq. 4, Manual \#2)}$$

It was assumed that t_c for street flow was equal to t_c for pipe flow. This is a conservative assumption, as pipe velocities generally exceed gutter velocities.

For local streets, curb-deep flow is tolerable for the minor storm.

Inlet capacities were determined by the methods presented in Manual #2, using Chart No. 12.

In this analysis, City of Wichita Type 1A inlets and 3/8 in./ft. street cross-slope were assumed to be utilized. Minimum walk grade was assumed as 0.3 feet above the top of curb, except as otherwise noted. Local streets are assumed to have roll curb and gutter, unless otherwise noted.

All storm sewer systems serve residential streets. Therefore, the design minor storm has a recurrence interval of two years, and the major storm one hundred years. Systems are designed for the minor storm with major storm overflows directed around home sites across open space in the golf course, or down street rights-of-way.

To simplify analysis, the following assumptions were made:

1. The time of concentration is identical for both the major and minor storm.

2. The street conveyance was analyzed using only the street width. Depths above the 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 the relatively higher "n" factor. Again, Eq. 4 of Manual #2 was used.

Hydraulic computations for the pipe system were performed using PEC's Storm Program. This program uses Manning's Equation to calculate friction losses in pipes flowing full. Minor losses are computed by momentum principles at each structure. All pipes were assumed to be reinforced concrete with a Manning's "n" factor of 0.013. It is desirable to keep the hydraulic grade line approximately one foot below the top of curb elevations for the minor storm.

Open channel flow analysis was analyzed using Manning's Equation, in accordance with Section G3 of the Design Manual, using the charts presented in KDOT Design Manual Volume III.

CLUBHOUSE POND

This pond was originally sized to store the 100 year runoff volume from its basin without discharge. The static pool elevation was to be maintained via pumping through the golf course irrigation system.

With the development of this plat, there is an opportunity to install a small capacity drawdown pipe which can maintain the static pool elevation by means of a gravity storm sewer. This outlet pipe must be constructed with a constriction at the inlet end so as to minimize the discharge during a rainfall event.

This study has been performed assuming a constant discharge of 2 cfs, which would draw the pond down from its design volume in three days.

MAJOR STORM FLOW

This development will utilize the golf course open space to store/carry major storm flows. A continuous open channel system has not been designed; however, the adjacent homes are to be constructed higher than any adjacent critical overflow point. Ponding will occur on the golf course whenever the storm sewer system has reached capacity; however, positive grading will direct all ponded areas to an inlet and as the storm recedes, the ponding will recede.

Turfed open area ponding will serve the following functions:

1. Detain floodwaters and thus reduce peak flowrates by virtue of storage.

2. Detain floodwaters and thus reduce peak flowrates by virtue of infiltration.

3. Will allow suspended solids to settle out.

4. Will act to filter some stormwater pollutants.

DRAINAGE MAP

A 1" = 50' scale drainage map is included in a map pocket at the back of the report.

REFLECTION RIDGE 9TH ADDITION DRAINAGE PLAN
HYDROLOGY ANALYSIS
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
M. W. BERRY, P.E. 11/21/92

NOTE:GC=GOLF COURSE
RES=1/4 AC RESIDENTIAL (38% IMPERVIOUS)

TWO YEAR STORM

BASIN	HYDRO-LOGIC SOIL GROUP	LAND USE	RUNOFF COEFF C	TIME OF CONC Tc,MIN	RAINFALL INTENSITY i,IN/HR	AREA A,AC	RUNOFF Q CU FT/SEC
1105	B	100% GC	0.16	15.00	3.83	0.23	0.14
1106	B	33% RES;67% GC	0.25	15.00	3.83	0.40	0.39
1107	B	100% RES	0.44	15.00	3.83	1.25	2.10
1108N	B	100% RES	0.44	15.00	3.83	1.07	1.80
1108S	B	100% RES	0.44	15.00	3.83	2.47	4.16
1109	B	33% RES;67% GC	0.25	15.00	3.83	0.70	0.68
1110	B	33% RES;67% GC	0.25	15.00	3.83	0.70	0.68
1111	B	33% RES;67% GC	0.25	15.00	3.83	0.83	0.80
1112	B	33% RES;67% GC	0.25	15.00	3.83	3.46	3.35
1200	B	33% RES;67% GC	0.25	15.00	3.83	5.53	5.36
1300	B	100% RES	0.44	15.00	3.83	0.82	1.39

##########

100-YEAR STORM

BASIN	HYDRO-LOGIC SOIL GROUP	LAND USE	RUNOFF COEFF C	TIME OF CONC Tc,MIN	RAINFALL INTENSITY i,IN/HR	AREA A,AC	RUNOFF Q CU FT/SEC
1105	B	100% GC	0.37	15.00	7.37	0.23	0.63
1106	B	33% RES;67% GC	0.45	15.00	7.37	0.40	1.34
1107	B	100% RES	0.61	15.00	7.37	1.25	5.61
1108N	B	100% RES	0.61	15.00	7.37	1.07	4.79
1108S	B	100% RES	0.61	15.00	7.37	2.47	11.11
1109	B	33% RES;67% GC	0.45	15.00	7.37	0.70	2.33
1110	B	33% RES;67% GC	0.45	15.00	7.37	0.70	2.33
1111	B	33% RES;67% GC	0.45	15.00	7.37	0.83	2.75
1112	B	33% RES;67% GC	0.45	15.00	7.37	3.46	11.47
1200	B	33% RES;67% GC	0.45	15.00	7.37	5.53	18.33
1300	B	100% RES	0.61	15.00	7.37	0.82	3.70

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Date 11/21/92 MWB Page _____ of _____

Project REFLECTION RIDGE 9TH DRAINAGE PLAN

Item INLET SIZING (2-YR)

All inlets are Sumps.

NODE	SIZE & TYPE	Q cfs	PONDING DEPTH, ft	REMARKS
1105	Ex. 4'x2' Area	0.14	<0.1'	OK
1106	4'x2' Area	0.4	<0.1'	OK
1107	5' IA Curb	2.1	0.2'	OK
1108	5' IA Curb	6.0	0.33'	OK
1109 1110	4'x2' Area	0.7	<0.1'	OK
1111	4'x2' Area	0.6	<0.1'	OK
1112	4'x2' Area	3.3	0.25'	OK

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Date 11/21/92 MAB Page ____ of ____

Project REFLECTION RIDGE 9TH ADD.

Item STREET FLOW

1107

$S = 0.4\%$

$Q_2 = 2.1$ CFS $Q_{100} = 5.6$ CFS

$Z = 1/32$ $n = 0.016$ $Z/n = 2000$

$d_2 = 0.27'$ OK FOR ROLL CURB

$d_{100} = 0.39'$ OK " " "

1108N $S = 0.5\%$ $Q_2 = 1.8$ CFS $Q_{100} = 4.8$ CFS

OK BY INSPECTION (SEE 1107) FOR ROLL CURB

1108S $S = 0.4\%$ $Q_2 = 4.2$ CFS $Q_{100} = 11.1$ CFS

$d_2 = 0.36$ FT @ TOP OF ROLL CURB OK

$d_{100} = 0.48$ FT OK

Roll Curb OK.

NOTE: CONDITIONS AT SUMP CHECKED ONLY. DUE TO SMALLER Q's & STEEPER GRADES, ALL OTHER CONDITIONS OK BY INSPECTION

1300 $S = 1.2\%$ $Q_2 = 1.4$ CFS $Q_{100} = 3.70$ CFS

$d_2 = 0.19'$ OK

$d_{100} = 0.27'$ OK

USE ROLL CURB THROUGHOUT

```
100 j,  141.7000 1105    4    9    8
110 t,Reflection Ridge 9th Addition Drainage Plan
120 t,Two Year Analysis
130 t,Professional Engineering Consultants, P.A.
140 t,Computed by M. W. Berry, P.E.  11/21/92   file:c:\rr9th\rr9th.stm
150 i, 1113     0.00     0.00     0.00     0.00     2.00    15.00   145.00
160 i, 1112     0.25     3.46     0.00     0.00     3.35    15.00   143.50
170 i, 1111     0.25     0.83     0.00     0.00     0.80    15.00   143.50
180 i, 1110     0.25     0.70     0.00     0.00     0.68    15.00   143.00
190 i, 1109     0.25     0.70     0.00     0.00     0.68    15.00   143.00
200 i, 1108     0.44     3.54     0.00     0.00     5.96    15.00   145.50
210 i, 1107     0.44     1.25     0.00     0.00     2.10    15.00   145.50
220 i, 1106     0.25     0.40     0.00     0.00     0.39    15.00   143.00
230 i, 1105     0.16     0.23     0.00     0.00     0.14    15.00   142.75
240 p, 1113 1112   140.00   12 0.013   0.00   0.00
250 p, 1112 1111   135.00   24 0.013  40.00   0.00
260 p, 1111 1110   260.00   24 0.013   0.00   0.00
270 p, 1110 1109   170.00   24 0.013   0.00   0.00
280 p, 1109 1106   170.00   24 0.013  70.00   0.00
290 p, 1108 1107    30.00   15 0.013  15.00   0.00
300 p, 1107 1106   130.00   18 0.013  20.00   0.00
310 p, 1106 1105   110.00   30 0.013  50.00   0.00
320 e
```

Date: 11-21-1992
Time: 09:48:42

Input File: c:\rr9th\rr9th.stm

Reflection Ridge 9th Addition Drainage Plan
Two Year Analysis
Professional Engineering Consultants, P.A.
Computed by M. W. Berry, P.E. 11/21/92 file:c:\rr9th\rr9th.stm

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

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)
1113	1112	.00	.00	.00	.0	15.00	3.83	2.00	15.00	3.83	2.00	2.00	12"	2.55	140.00	.92	15.92
1112	1111	.25	3.46	.00	.0	15.00	3.83	3.35	15.92	3.73	3.26	5.26	24"	1.67	135.00	1.34	17.26
1111	1110	.25	.83	.00	.0	15.00	3.83	.80	17.26	3.59	.75	6.01	24"	1.91	260.00	2.27	19.53
1110	1109	.25	.70	.00	.0	15.00	3.83	.68	19.53	3.37	.60	6.61	24"	2.10	170.00	1.35	20.87
1109	1106	.25	.70	.00	.0	15.00	3.83	.68	20.87	3.26	.58	7.19	24"	2.29	170.00	1.24	22.11
1108	1107	.44	3.54	.00	.0	15.00	3.83	5.96	15.00	3.83	5.96	5.96	15"	4.86	30.00	.10	15.10
1107	1106	.44	1.25	.00	.0	15.00	3.83	2.10	15.10	3.82	2.09	8.05	18"	4.56	130.00	.48	15.58
1106	1105	.25	.40	.00	.0	15.00	3.83	.39	22.11	3.16	.32	14.28	30"	2.91	110.00	.63	22.74

Date: 11-21-1992
Time: 09:48:42

Input File: c:\rr9th\rr9th.stm

Reflection Ridge 9th Addition Drainage Plan
Two Year Analysis
Professional Engineering Consultants, P.A.
Computed by M. W. Berry, P.E. 11/21/92 file:c:\rr9th\rr9th.stm

Storm Frequency = 2-Year

* * * HYDRAULICS* * *

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)
1113	.00315	.4412	.0000	.0000	.0000	.0000	.0000	.4412	143.1020	145.0000	1.90
1112	.00054	.0730	.0000	.0114	.0000	.0000	.0681	.1525	142.6608	143.5000	.84
1111	.00071	.1835	.0000	.0013	.0000	.0082	.0297	.2228	142.5083	143.5000	.99
1110	.00085	.1451	.0000	.0012	.0000	.0000	.0277	.1740	142.2855	143.0000	.71
1109	.00101	.1716	.0000	.0013	.0000	.0000	.0299	.2028	142.1115	143.0000	.89
1108	.00851	.2554	.0000	.0000	.0000	.0000	.0000	.2554	143.1556	145.5000	2.34
1107	.00588	.7641	.0000	.0088	.0000	.0213	.1972	.9915	142.9002	145.5000	2.60
1106	.00121	.1334	.0000	.0382	.0000	.0265	.0106	.2087	141.9087	143.0000	1.09
1105	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	141.7000	142.7500	1.05

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Date 11-21-92 MWB Page ____ of ____

Project REFL R 9TH ADD DRAIN PLAN

Item DITCH ALONG NORTH SIDE CENTRAL PARK

REFERENCE KDOT Vol III

DESIGN DITCH ALONG EDGE OF DRIVING RANGE

Q_2 = 5.4 CFS
Q_{10} = 12 CFS
Q_{100} = 18.3 CFS

RETARDANCE CLASS E
10' FLAT BOTTOM 4:1 Slope 1%

FROM Fig 30-4-1-1-E

Maximum Permissible Depth (Non-Erosive) = 0.62 ft

From Fig 30-4-1-1-3-A+B

For B = 10'
d = 0.6'
A = 7.6 ft²
R = 0.5'

From Fig 30-4-1-1-E

V = 2.8 ft/s
Q = AV = 21. cfs ⟹ OK > 100 Yr

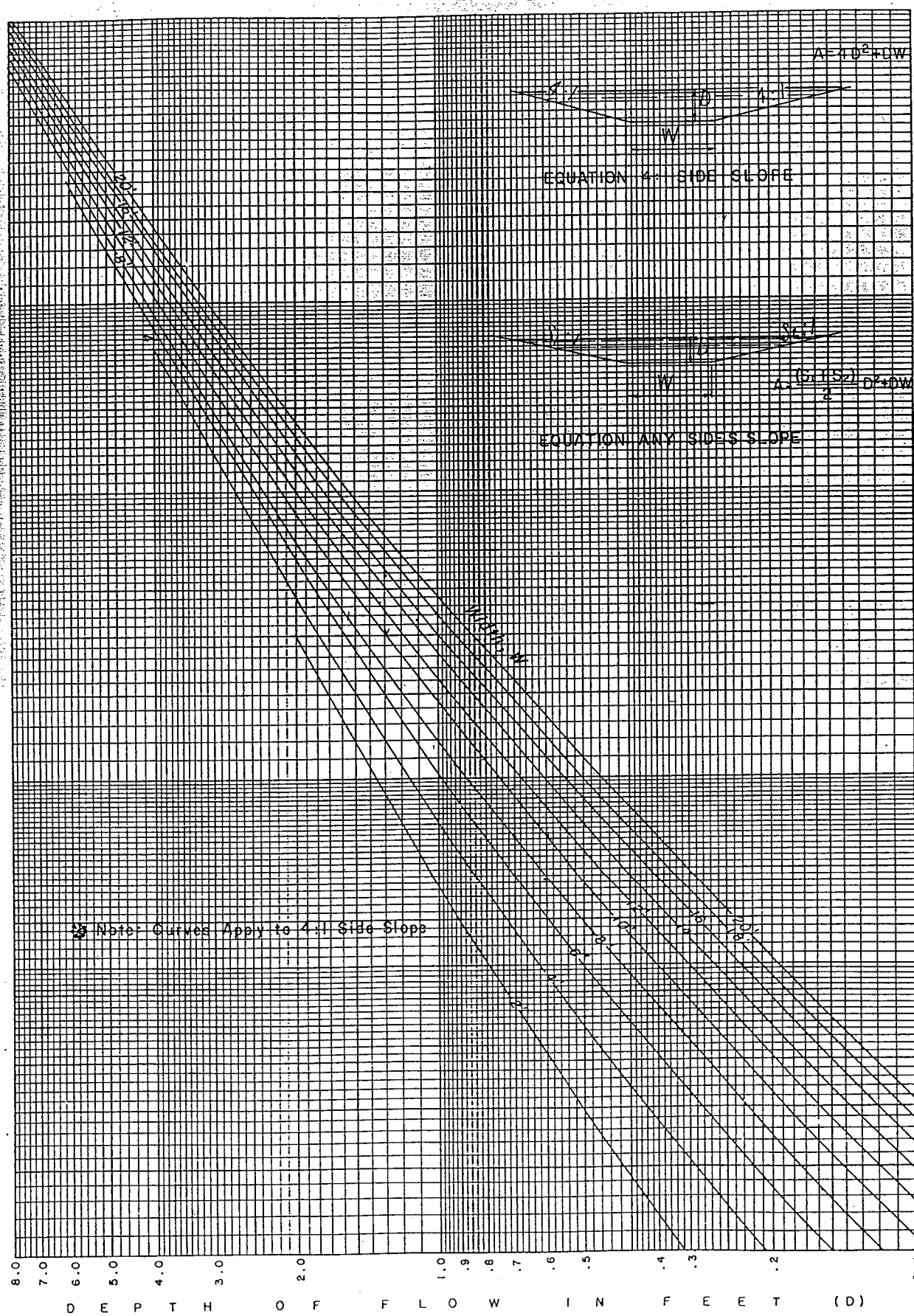
100 Yr Non-Erosive if grass is established

CHECK Q_{10} ON SEEDED & MULCHED DITCH

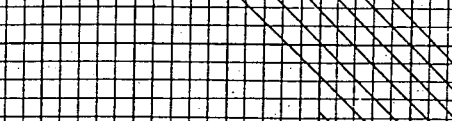
From Fig 30-4-1-1-3-A+B
B = 10'
d = 0.4'
A = 4 ft²
R = 0.35'

Find $V = 32.766\, R^{0.661}\, S^{0.387}$ = 2.8 ft/s (EQ. FROM FIG 30-4-1-2-A)
Q = AV = 4 x 2.8 = 11.25 cfs ≈ MARGINAL EROSION FOR Q_{10} = 12 CFS.

HYDRAULIC PROPERTIES OF TRAPEZOIDAL CHANNELS (AREA OF FLOW)



HYDRAULIC PROPERTIES OF TRAPEZOIDAL CHANNELS (HYDRAULIC RADIUS)



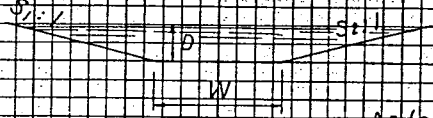
EQUATION 4:1 SIDE SLOPES

Area (A) = $4D^2 + DW$

Wetted Perimeter (W.P.) = $2\sqrt{17}\,D + W$

Hydraulic Radius (R) = $\frac{\text{Area}}{\text{W.P.}}$

$= \frac{4D^2 + DW}{2\sqrt{17}\,D + W}$



EQUATION ANY SIDE SLOPE

$A = \frac{(S_1 + S_2)}{2} D^2 + DW$

$W.P. = \left(\sqrt{S_1^2 + 1} + \sqrt{S_2^2 + 1}\right) D + W$

$R = \frac{A}{W.P.}$

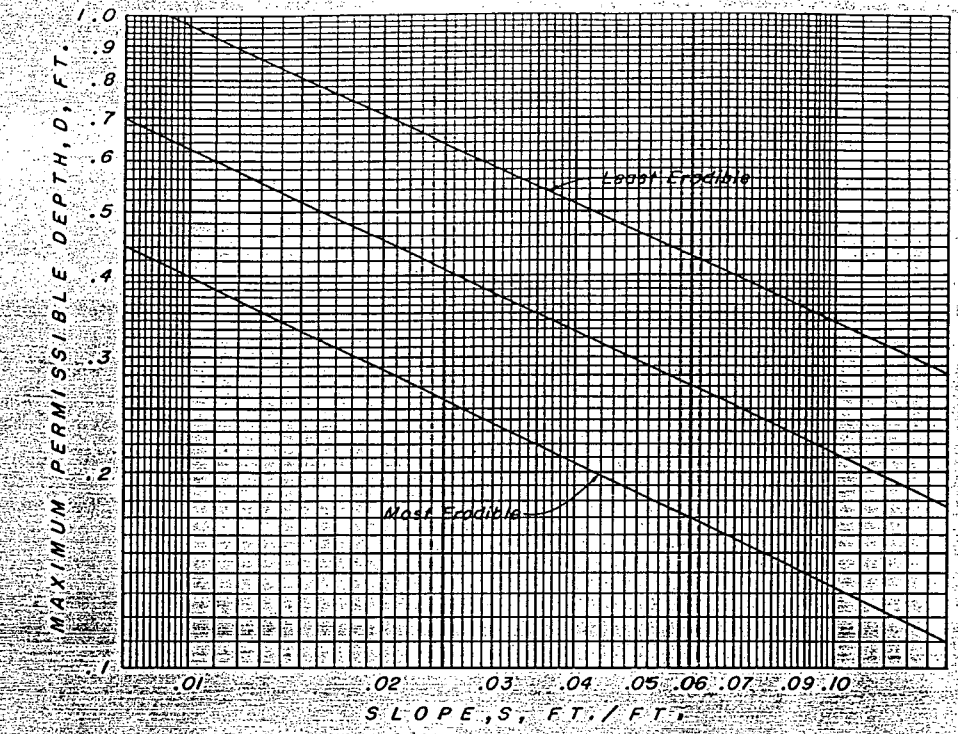
W.D. = W. IN FEET

Note: Curves apply to 4:1 Side Slopes

HYDRAULIC RADIUS IN FEET (R)

DEPTH OF FLOW IN FEET (D)

RETARDANCE CLASS E



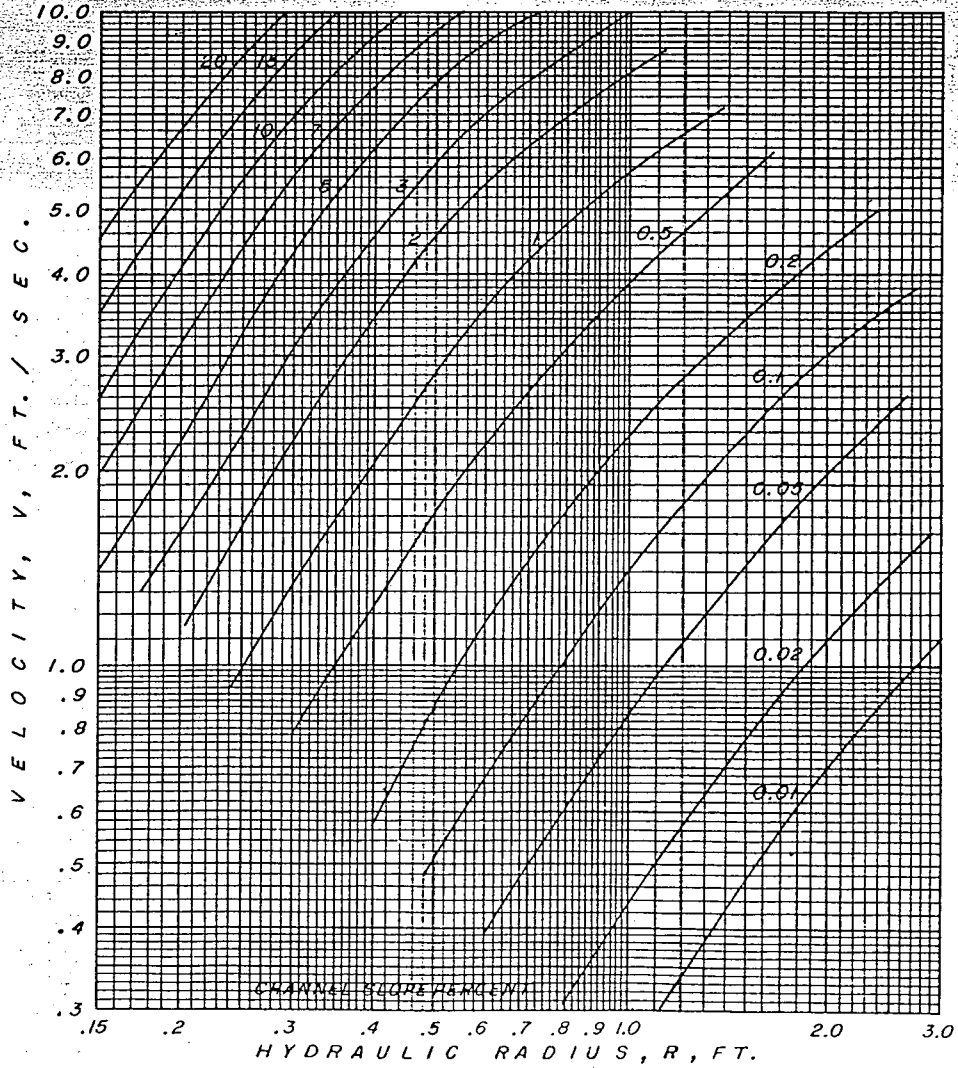


Figure 3D-4-1-1-E

CURRENT DATE: 11-21-1992 FILE DATE: 11-21-1992
CURRENT TIME: 10:57:40 FILE NAME: RR91200

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 3.2 **********
****

CULV #	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	141.25	138.00	75.07	1 RCP	1.50	1.50	.012	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (CFS) FILE: RR91200 DATE: 11-21-1992

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
142.25	0	0	0	0	0	0	0	0	1
142.34	2	2	0	0	0	0	0	0	1
142.46	4	4	0	0	0	0	0	0	1
142.64	5	5	0	0	0	0	0	0	1
143.02	8	8	0	0	0	0	0	0	1
143.42	10	10	0	0	0	0	0	0	1
143.94	12	12	0	0	0	0	0	0	1
144.55	14	14	0	0	0	0	0	0	1
145.25	16	16	0	0	0	0	0	0	1
145.92	18	18	0	0	0	0	0	0	30
146.05	20	18	0	0	0	0	0	2	14
146.00	18	18	0	0	0	0	0	OVERTOPPING	

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: RR91200 DATE: 11-21-1992

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
142.25	0.00	0	0	0.00
142.34	0.00	2	0	0.00
142.46	0.00	4	0	0.00
142.64	0.00	5	0	0.00
143.02	0.00	8	0	0.00
143.42	0.00	10	0	0.00
143.94	0.00	12	0	0.00
144.55	0.00	14	0	0.00
145.25	0.00	16	0	0.00
145.92	-0.01	18	0	1.72
146.05	-0.00	20	0	0.77

****

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 11-21-1992 FILE DATE: 11-21-1992
CURRENT TIME: 10:57:40 FILE NAME: RR91200

****
********** CULVERT # 1 **********
****

PERFORMANCE CURVE FOR 1 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	142.25	142.25	0.00	1.00	0-NF	0.00	141.25	0.00	0.00
2	142.34	142.25	0.70	1.09	1-S1	0.00	0.00	0.00	1.13
4	142.46	142.25	1.06	1.21	1-S1	0.00	0.00	0.00	2.26
5	142.64	142.25	1.26	1.39	1-S1	0.00	0.00	0.00	3.06
8	143.02	142.25	1.64	1.77	1-S1	0.00	0.00	0.00	4.53
10	143.42	142.25	1.99	2.17	4-FF	0.00	0.00	0.00	5.66
12	143.94	142.25	2.41	2.69	4-FF	0.00	0.00	0.00	6.79
14	144.55	142.25	2.91	3.30	4-FF	0.00	0.00	0.00	7.92
16	145.25	142.25	3.46	4.00	4-FF	0.00	0.00	0.00	9.05
18	145.92	142.25	3.98	4.67	4-FF	0.00	0.00	0.00	10.01
18	146.05	142.25	4.08	4.80	4-FF	0.00	0.00	0.00	10.19

El. inlet face invert 141.25 ft El. outlet invert 138.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

****

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	141.25
OUTLET STATION (FT)	75.00
OUTLET ELEVATION (FT)	138.00
NUMBER OF BARRELS	1.00
SLOPE (V-FT/H-FT)	0.0433
CULVERT LENGTH ALONG SLOPE (FT)	75.07

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	1.50 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END IN HEADWALL
INLET DEPRESSION	NONE

****

CURRENT DATE: 11-21-1992 FILE DATE: 11-21-1992
CURRENT TIME: 10:57:40 FILE NAME: RR91200

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
142.25 = 1' below T.C.

****
********** ROADWAY OVERTOPPING DATA **********
****

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH (FT)	4.00
CREST LENGTH (FT)	50.00
OVERTOPPING CREST ELEVATION (FT)	146.00

****

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Date 11/21/92 MWB Page ____ of ____

Project REFLECTION RIDGE 9TH ADDITION

Item CLUBHOUSE POND LAKE #3

DESIGN PARAMETERS: (SEE 6 SHEETS FROM REFLECTION RIDGE DRAINAGE PLAN

DESIGN STATIC POOL = 140.8
100 YR DWS = 146.0
STORAGE VOLUME = 12 AC-FT

Problem: Drain lake down to static pool in reasonable time

$$12 \text{ Ac Ft} \times \frac{43560 \text{ FT}^2}{\text{AC}} = 522{,}000 \text{ CU FT}$$

$$\text{ONE DAY} \times \frac{24 \text{ HR}}{\text{DAY}} \times \frac{60 \text{ MIN}}{\text{HR}} \times \frac{60 \text{ SEC}}{\text{MIN}} = 86{,}400 \text{ SEC}$$

TO DRAIN IN ONE DAY: $\frac{522{,}000}{86{,}400} = 6.0$ CFS

TWO DAY: 3 CFS

THREE DAY 2 CFS ≈ 900 GPM

WK ≈ 1 CFS

SELECT 3 DAYS

PROJECT DESIGN MUST INCORPORATE A WEIR OR ORIFICE PLATE AT THE POND OUTLET TO RESTRICT FLOWS TO ≈ 2 CFS.

2 CFS WILL BE ADDED TO STORM SEWER SYSTEM AT NODE 1113 FOR Z-YR ANALYSIS

 Pond #3 Outlet w/o Orifice

CURRENT DATE: 11-21-1992
CURRENT TIME: 09:42:18

FILE DATE: 11-21-1992
FILE NAME: RR9POND3

****
FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2
****

CULV #	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	140.80	139.00	140.01	1 RCP	1.00	1.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (CFS) FILE: RR9POND3 DATE: 11-21-1992

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
143.50	0	0	0	0	0	0	0	0	1
143.62	1	1	0	0	0	0	0	0	1
143.99	2	2	0	0	0	0	0	0	1
144.61	3	3	0	0	0	0	0	0	1
145.48	4	4	0	0	0	0	0	0	1
145.57	5	4	0	0	0	0	0	0	30
145.71	6	4	0	0	0	0	0	0	30
145.85	7	4	0	0	0	0	0	0	30
145.99	8	4	0	0	0	0	0	0	30
146.03	9	5	0	0	0	0	0	4	20
146.04	10	5	0	0	0	0	0	5	10
146.00	4	4	0	0	0	0	0	OVERTOPPING	

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: RR9POND3 DATE: 11-21-1992

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
143.50	0.00	0	0	0.00
143.62	0.00	1	0	0.00
143.99	0.00	2	0	0.00
144.61	0.00	3	0	0.00
145.48	0.00	4	0	0.00
145.57	-0.00	5	1	18.30
145.71	-0.00	6	2	29.63
145.85	-0.00	7	3	37.77
145.99	-0.00	8	4	43.93
146.03	-0.00	9	0	0.99
146.04	-0.00	10	0	0.76

****

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 11-21-1992 FILE DATE: 11-21-1992
CURRENT TIME: 09:42:18 FILE NAME: RR9POND3

****
********** CULVERT # 1 **********
****

PERFORMANCE CURVE FOR 1 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	143.50	143.50	0.00	2.70	0-NF	0.00	140.80	0.00	0.00
1	143.62	143.50	0.58	2.82	4-FF	0.00	0.00	0.00	1.27
2	143.99	143.50	0.87	3.19	4-FF	0.00	0.00	0.00	2.55
3	144.61	143.50	1.14	3.81	4-FF	0.00	0.00	0.00	3.82
4	145.48	143.50	1.48	4.68	4-FF	0.00	0.00	0.00	5.09
4	145.56	143.50	1.51	4.76	4-FF	0.00	0.00	0.00	5.20
4	145.70	143.50	1.57	4.90	4-FF	0.00	0.00	0.00	5.38
4	145.85	143.50	1.62	5.05	4-FF	0.00	0.00	0.00	5.55
4	145.99	143.50	1.68	5.19	4-FF	0.00	0.00	0.00	5.71
5	146.03	143.50	1.70	5.23	4-FF	0.00	0.00	0.00	5.76
5	146.03	143.50	1.70	5.23	4-FF	0.00	0.00	0.00	5.76

El. inlet face invert 140.80 ft El. outlet invert 139.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

****

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	140.80
OUTLET STATION (FT)	140.00
OUTLET ELEVATION (FT)	139.00
NUMBER OF BARRELS	1.00
SLOPE (V-FT/H-FT)	0.0129
CULVERT LENGTH ALONG SLOPE (FT)	140.01

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	1.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END IN HEADWALL
INLET DEPRESSION	NONE

****

CURRENT DATE: 11-21-1992
CURRENT TIME: 09:42:18

FILE DATE: 11-21-1992
FILE NAME: RR9POND3

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
143.50

****
********** ROADWAY OVERTOPPING DATA **********
****

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH (FT)	8.00
CREST LENGTH (FT)	270.00
OVERTOPPING CREST ELEVATION (FT)	146.00

****

Date 4.2.87 Page 1 of 6

Project Reflection Ridge Addition

Item Drainage Plan Pond No. 3

Determine Total Q entering pond during 100-yr. storm:

A) Overflow From System 200
$= Q_{100} - Q_2$
$= 118.0 - 42.4 = 75.6$ cfs @ tc 26.8 + Travel Time to Pond 3 = 33.5

B) Q_{100} System 300 = 98.1 cfs @ tc 26.7

C) Area Adjacent to Pond which drains directly into pond.

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

C = 90% Golf Course, Type B, 1-4%
5% Res.
5% Drives, Walks

$C = (0.9 \times 0.41) + (0.05 \times 0.61) + (0.05 \times 0.89)$
$= 0.44$

t_c = 400' @ ≈1% overland = 0.28 fps = 23.8
+ 1000' swale @ ≈ 3fps = 5.5
29.3

$I_{100} = 5.46$

$A = 26.45$

$Q_{100} = 0.44 \times 5.46 \times 26.45$

$= 63.5$ cfs @ tc 29.3 min.

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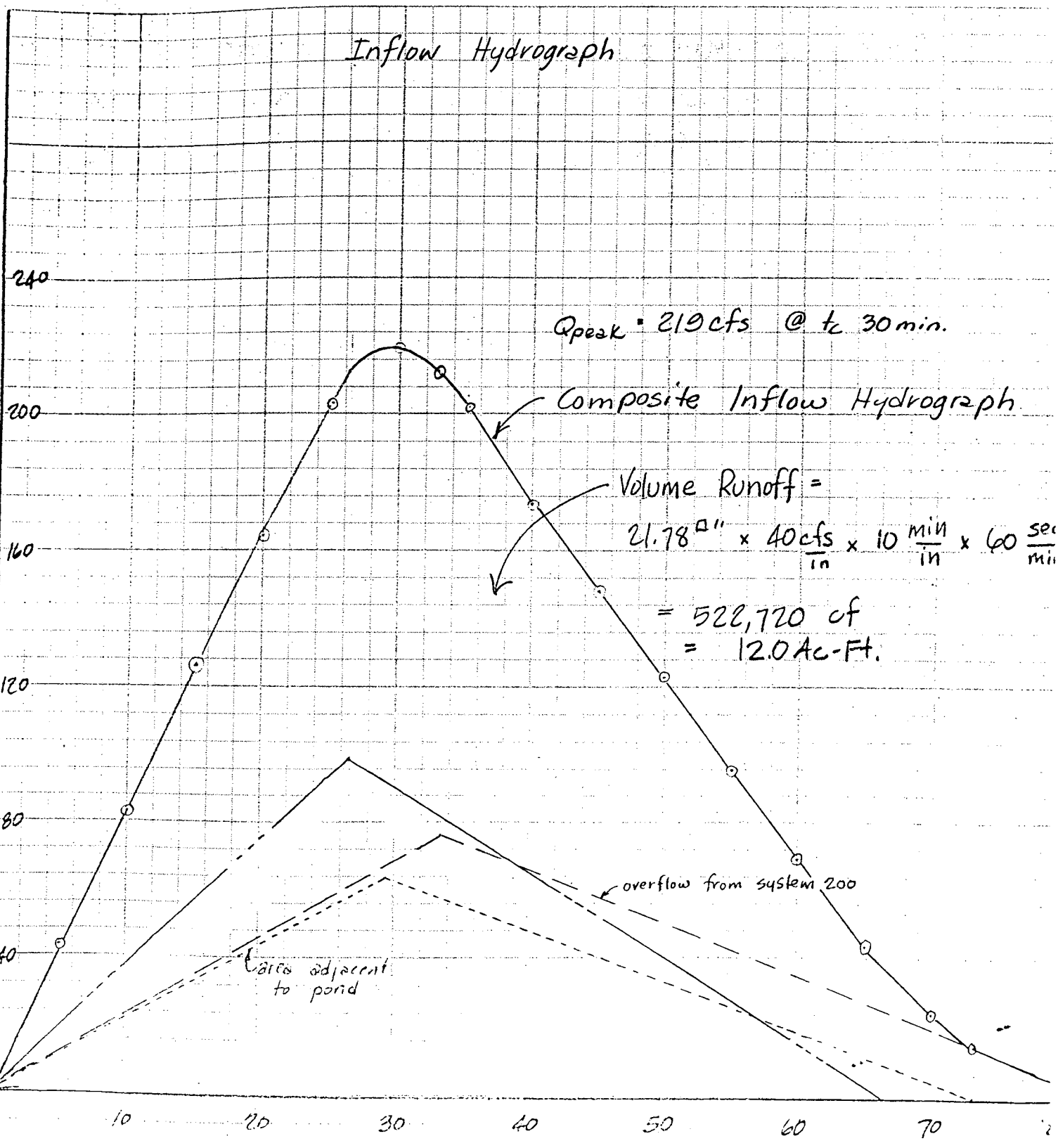
Date 4.2.87 Page 2 of 6

Project Reflection Ridge

Item Drainage Plan Pond No. 3



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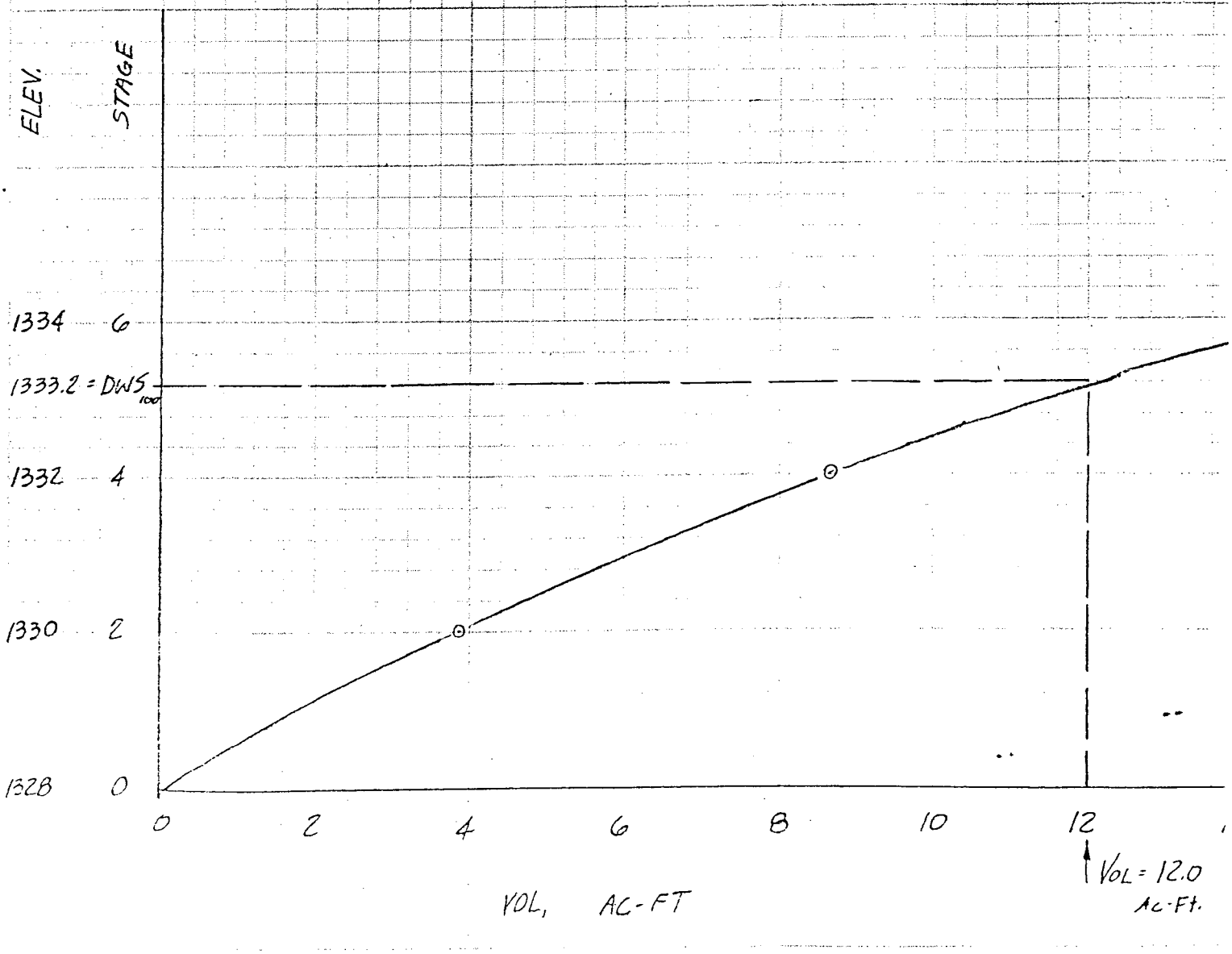
Date 7·27·87 Page 3 of 6

Project Reflection Ridge

Item Drainage Plan Pond No. 3

Elev.	Stage	Area	Δd	Volume	Σ Vol.
1328.0	0	1.79 Ac.	0	0	0
1330.0	2'	2.10	2'	3.89	3.89
1332.0	4'	2.66	2'	4.74	8.63
1334.0	6'	4.03	2'	6.64	15.27

(Based on Grading Plan - See Page 7)



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Date 7.27.87 Page 4 of 6

Project Reflection Ridge

Item Drainage Plan Pond No. 3

SUMMARY

Inflow Q_{peak} (100-yr) = 219 cfs @ t_c = 30 min.

Inflow Volume (100-yr) = 12.0 Ac-Ft.

Based on Preliminary Grading Plan DWS_{100} = 1333.2
Static Pool = 1328.0 (See Page 6)

Static Pool Elevation to be maintained via pumping & irrigation system associated with golf course.

Entire 100 year storm can be stored in pond without discharge.

Emergency Overflow Swale to be provided. Assume Pond No. 3 is full. Design swale for 2-year storm. (See Page 5 of this section).

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Date July 28, 1987 Page 5 of 6

Project Reflection Ridge

Item Drainage Plan Pond No. 3

DESIGN EMERGENCY OVERFLOW CHANNEL FOR 2-YEAR

A) STORM SEWER SYSTEM 200 — 29.2 cfs

B) AREA ADJACENT TO POND:

$Q_2 = C_2 I_2 A$

$= 0.3 \times 2.71 \times 26.45$

$= 21.5$

21.5

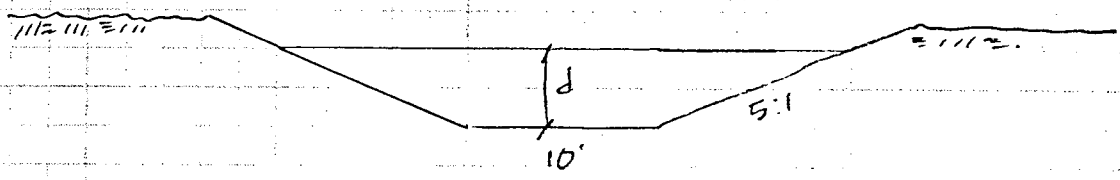
50.7 cfs

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

$AR^{2/3} = \frac{Q \times n}{1.486 \times S^{1/2}}$ where $Q = 50.7$, $n = 0.03$, $S = 0.50\%$

$AR^{2/3} = \frac{50.7 \times 0.03}{1.486 \times 0.07071} = \frac{1.521}{0.105}$

$= 14.4$



d	A	p	R	$R^{2/3}$	$AR^{2/3}$	
1.0	15.0	20.20	0.74	0.820	12.3	
1.1	17.05	21.22	0.80	0.864	14.7	← USE d = 1.1'

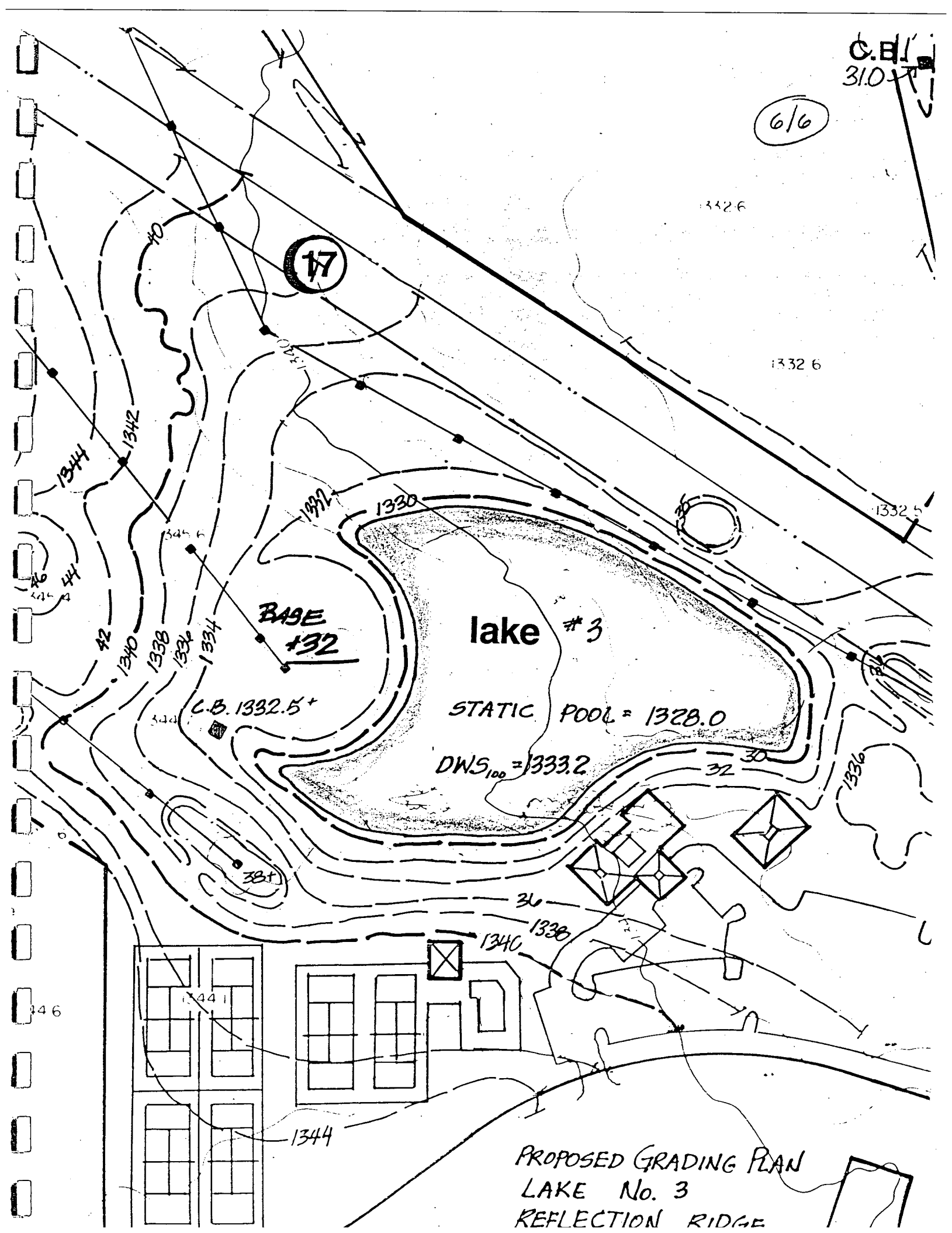
$V = Q/A = 3.0$ fps.

Emergency Elev. = E overflow + 1.1'

= 1333.5 + 1.1

= 1334.6

Set minimum pad 1335.0


C.B.
31.0
6/6
17
1332.6
1332.6
1332.5
1340
1342
1344
1330
1332
1334
1336
1338
1340
42
44
46
BASE
+32
lake #3
STATIC POOL = 1328.0
DWS100 = 1333.2
C.B. 1332.5+
38+
36
32
30
1344
1344
PROPOSED GRADING PLAN
LAKE No. 3
REFLECTION RIDGE

SEDGWICK COUNTY, KANSAS — SHEET NUMBER 33

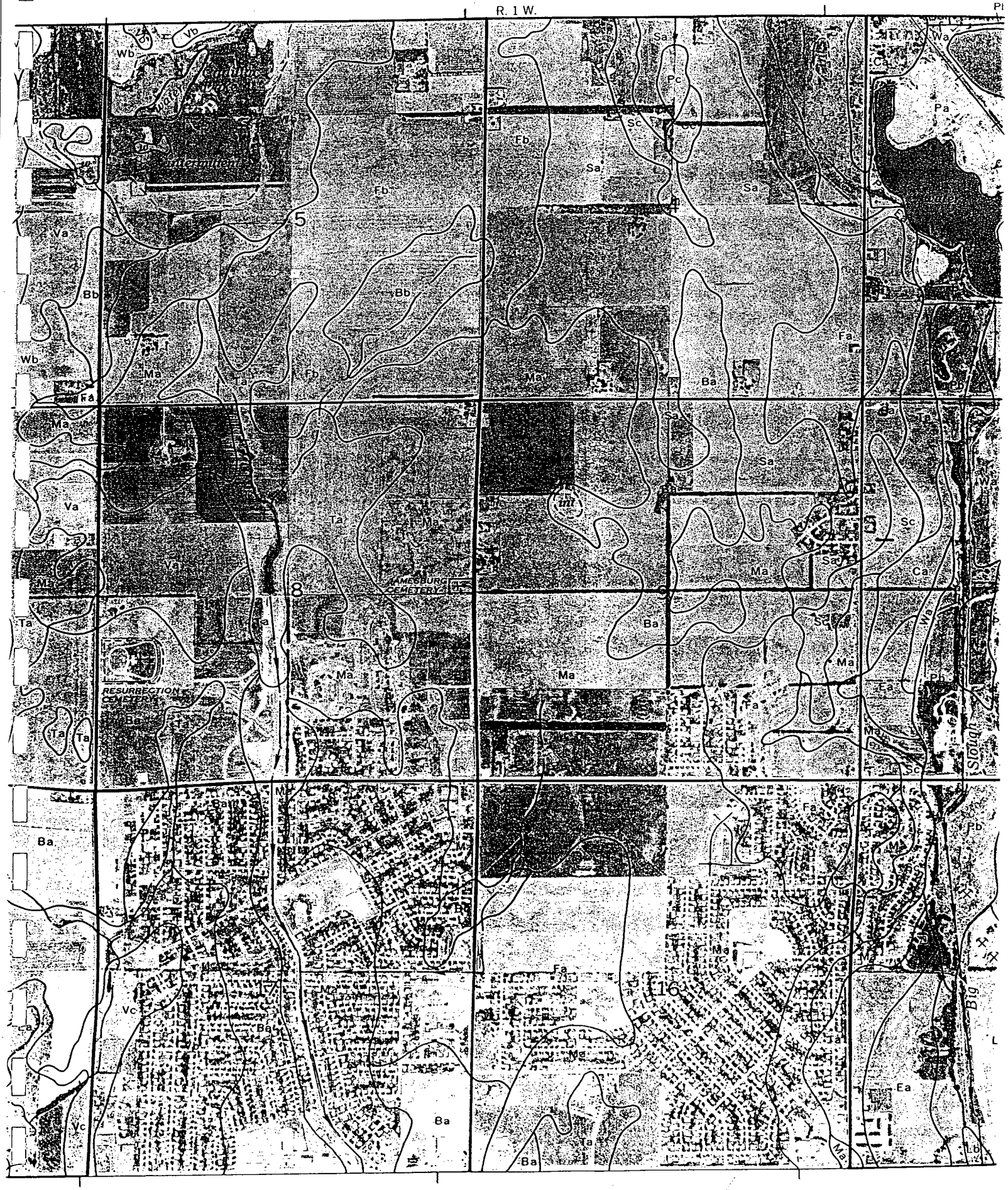


EXHIBIT NO. 1

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

(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 face 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
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 face 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.

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

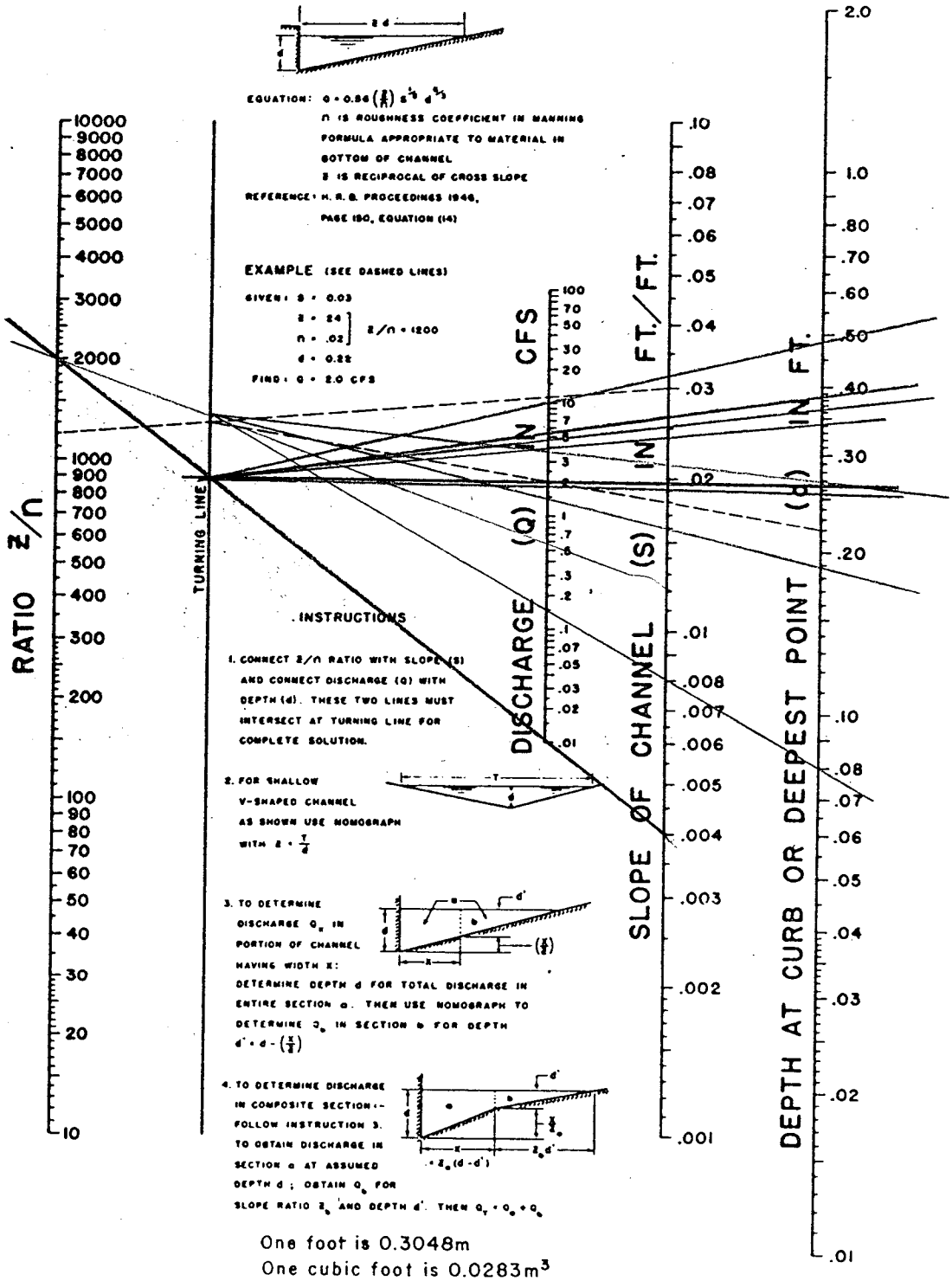
DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
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

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

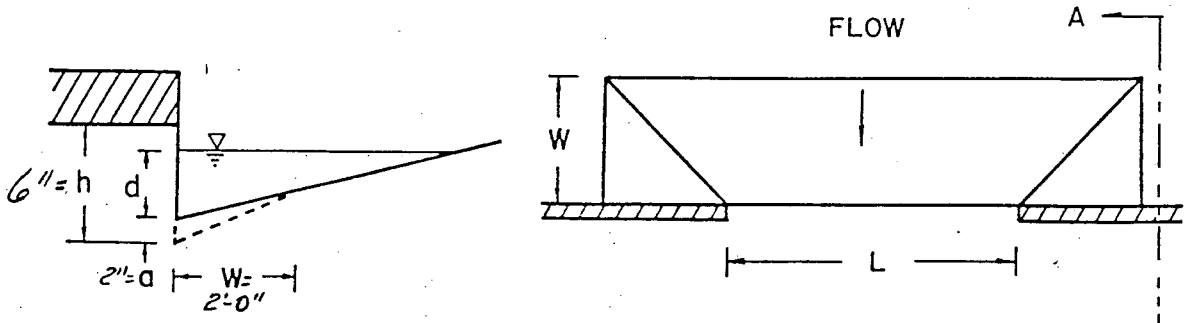
DURATION IN HOURS	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
2	0.81	0.99	1.33	1.55	1.81	2.07	2.30
3	0.59	0.72	0.97	1.13	1.32	1.51	1.68
4	0.47	0.58	0.78	0.91	1.06	1.21	1.35
5	0.40	0.49	0.66	0.77	0.89	1.02	1.14
6	0.35	0.42	0.57	0.67	0.78	0.89	0.99
8	0.28	0.34	0.46	0.53	0.62	0.71	0.79
10	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

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS



One foot is 0.3048m

One cubic foot is $0.0283 m^3$



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

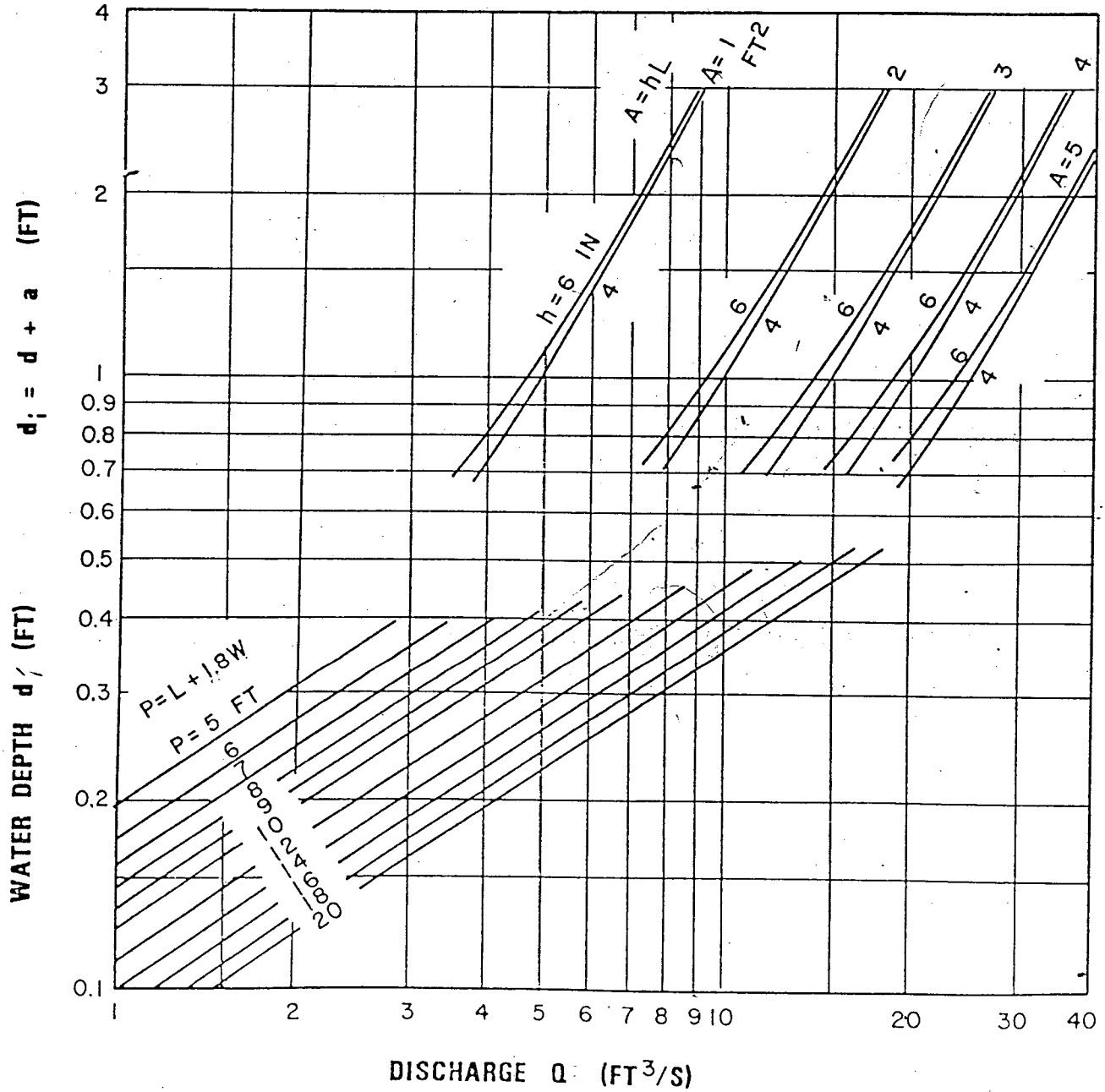


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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

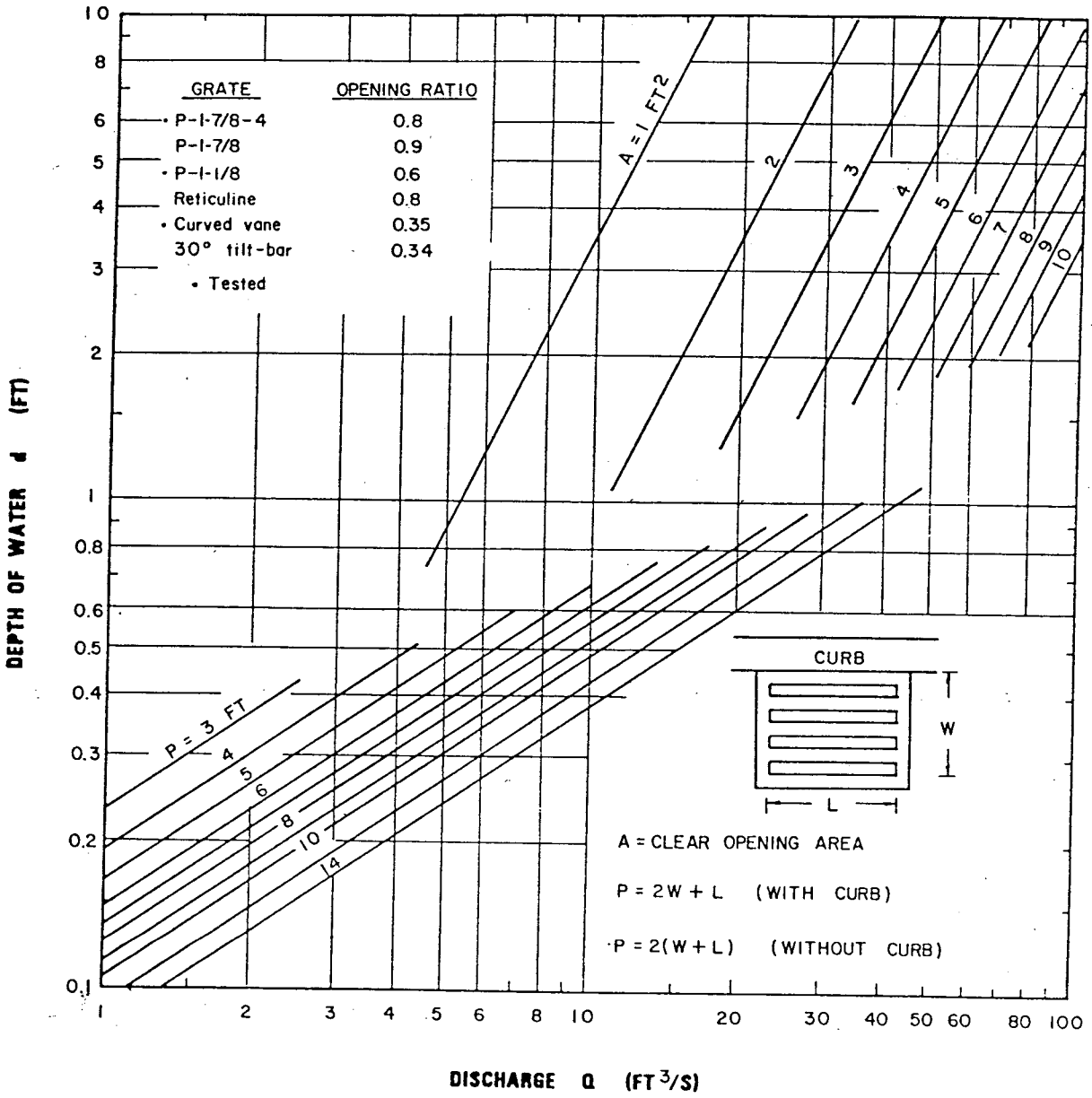


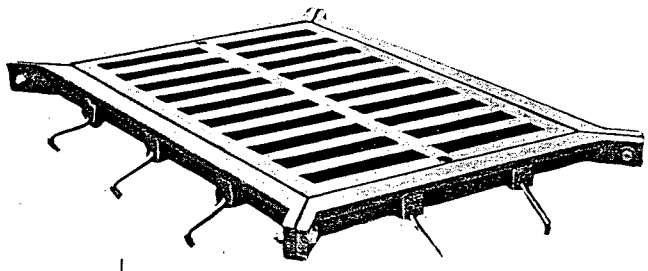
CHART 11. Grate inlet capacity in sump conditions.

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

Deeter Foundry, Inc.

P.O. Box 29278, Lincoln, Nebraska 68529

2425 Inlet Grate & Sectional Frame



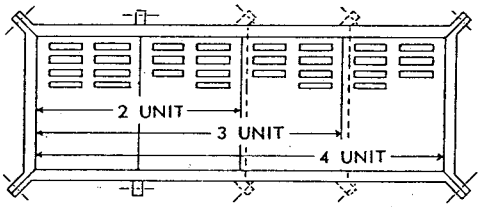
Heavy Duty

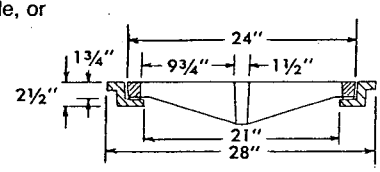
Total Wt. for single unit — 380#

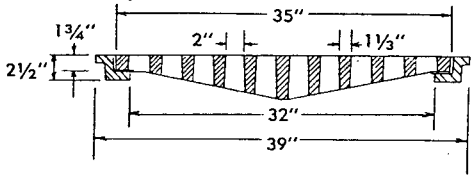
Open Area for single unit — 390 Sq. In.

1. Grates can be bolted to frames with ⅜"x 2" brass bolts.
2. Frequently used for airport installations.
3. If multiple units are desired specify double, triple, or quadruple units.

Drawing Illustrating Multiple 2425 Inlet Units







Also: Western Iron & Fdy Co. 400G Grate

2433-2434 Catch Basin Inlet Grate & Frame

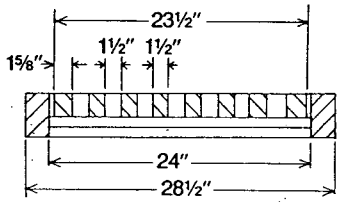
400F Frame (1 unit)
408F Frame (2 unit)

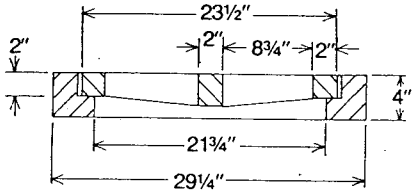
Heavy Duty **Open Area**

Total Wt. — 2433 — 520# — **184 Sq. In.**

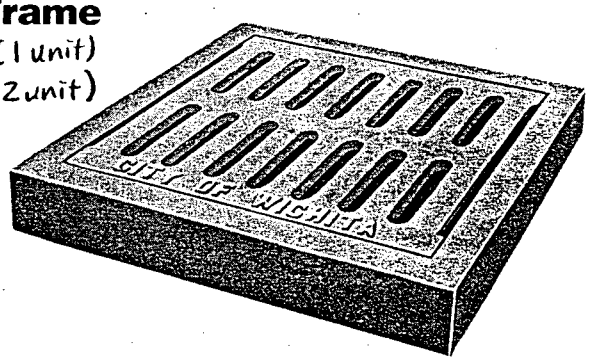
2434 — 890# — **368 Sq. In.**

1. 2434 frame requires two grates.

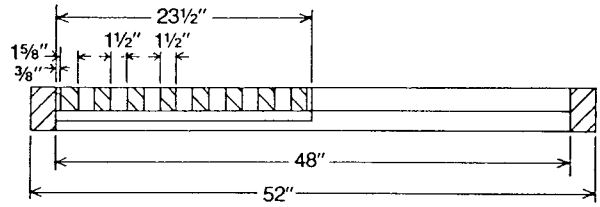




Drawing Illustrating 2433 Catch Basin Grate & Frame

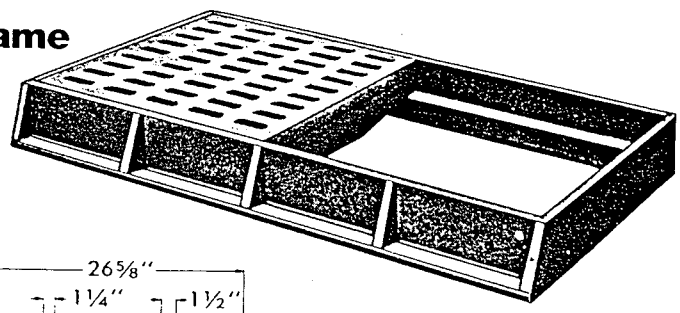


Illustrating 2433 Catch Basin Grate & Frame



Drawing Illustrating 2434 Catch Basin Grate & Frame

2435 Catch Basin Inlet Grate & Frame



Heavy Duty

Total Wt. — 1105#

Open Area — 473 Sq. In.

1. Frame requires two grates.