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GOLDEN HILLS 2ND ADDITION TO WICHITA, KANSAS

DRAINAGE PLAN & SUPPORTING CALCULATIONS

FOR
SUNRISE ENTERPRISES, LTD.
GODDARD, KANSAS

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

APRIL 11, 1986

1440 EAST ENGLISH
WICHITA, KANSAS 67211

PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

April 11, 1986

Mr. Michael E. Lindebak, P.E.,
City Engineer & Interim Director of Planning
City Hall - 7th Floor
455 North Main
Wichita, Kansas 67202

Attention: Mr. Chris Breitenstein, P.E.

Reference: Golden Hills 2nd Addition
Drainage Plan
PEC File No: 36-86120-1310

Dear Mr. Breitenstein:

Transmitted herewith are two (2) copies of the Drainage Plan and Supporting Calculations for the proposed Golden Hills 2nd Addition to the City of Wichita. The preliminary plat will be submitted today for hearing by the Subdivision Committee on April 24, 1986.

The street configuration in Golden Hills 2nd is slightly different than that shown on the preliminary plat for Golden Hills Addition, thus the drainage system is also different than shown in the Golden Hills Drainage Plan, dated June 7, 1985. The enclosed document includes calculations for the revised layout and also utilizes a detention pond to reduce the size of the outfall pipe.

Please review this data at your earliest convenience and advise our office of your comments. If you have any questions please call.

Very truly yours,

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

Charles S. Brown

Charles S. Brown, P.E.
Project Engineer

xc: Forrest Nagley, MAPD
Bill Solt, Sunrise Enterprises, Ltd.

CSB/mkm

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Project Golden Hills 2nd Addition

Item Drainage Plan

DETERMINE DRAINAGE AREAS

NODE	UNITS	SF	ACRES
908	11.27 □"	112,700	2.59
907	28.12 □"	281,200	6.46
906	15.39 □"	153,900	3.53
905	5.83 □"	58,300	1.34
904	7.72 □"	77,200	1.77
903	21.07 □"	210,700	4.84
902	20.71 □"	207,100	4.75
901	2.45 □"	24,500	0.56
900	—	(END SECTION)	

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Project Golden Hills 2nd Addition

Item Drainage Plan

DETERMINE PEAK DISCHARGES FROM EACH SUB-BASIN.

NODE	C*	t_c (min) ≠	I_2 (in/hr) *	A (acres)	Q_2 (cfs)
908	0.5	10	4.75	2.59	6.2
907	0.5	10	4.75	6.46	15.3
906	0.5	10	4.75	3.53	8.4
905	0.5	10	4.75	1.34	3.2
904	0.5	10	4.75	1.77	4.2
903	0.5	10	4.75	4.84	11.5
902	0.5	10	4.75	4.75	11.3
901	0.5	10	4.75	0.56	1.3
900	—	(END SECTION).			

* Average values used in Golden Hills 1st Add. Dr. Plan.

≠ Assumed value. Some values used in Golden Hills 1st Add'n. Drainage Plan

* From Weather Bureau Tech. Paper No. 40.

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Project Golden Hills 2nd Addn

Item Drainage Plan

Since some of the inlets in this system are on grade (not sump conditions), the amount of interception & bypass Q's must be determined prior to inputting data into storm sewer program. (Using 2-yr. storm).

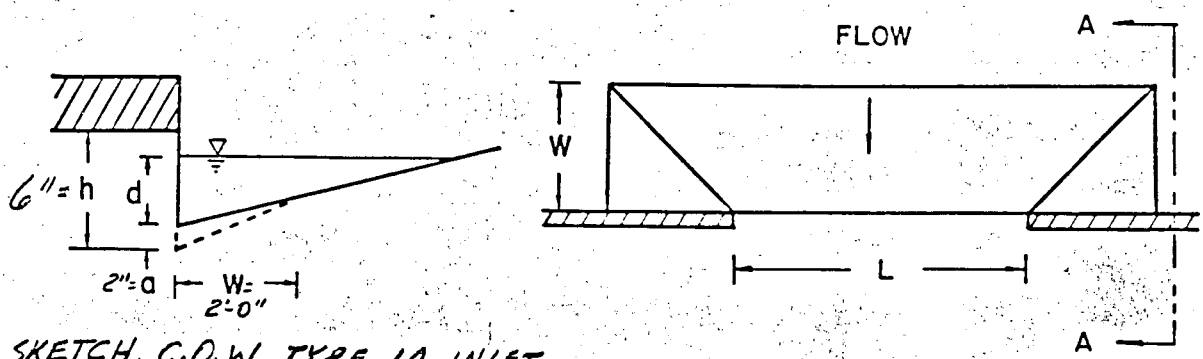
NODE	Q_o #	Q_b	Q_{total} *	Inlet L	Inlet Type	Inlet Cond.	Q_i ✱	Q_b
908	6.2	0.0	6.2	5'	1A	On Grade	1.6	4.6 (to node 9
907	15.3	0.0	15.3	10'	1A	Sump H=0.52' ## Max	12.0	3.3 (to node 90
906	8.4	3.3	11.7	10'	1A	On Grade	2.8	8.9 (to node 90
905	3.2	8.9	12.1	10'	1A	Sump H=0.52'	12.1	0.0
904	4.2	4.6	8.8	5'	1A	Sump H=0.52'	7.0	1.8 (to node 90
903	11.5	0.0	11.5	5'	1A	Sump H=0.52'	7.0	4.5 (to node 902
902	11.3	4.5	15.8	10'	1A	Sump H=0.52'	12.0	3.8 (to node 901
901	1.3	1.8 3.8	6.9	5'	1A	Sump H=0.71'	6.9	0.0
900	—	—						

Q_2 per sheet 2

* Q_{total} to be used in street flow calcs.

✱ Q_i = $Q_{interception}$ to be used in Storm Sewer Program.

H=0.52' (0.35' from E gutter to Crown + 2" depression)



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

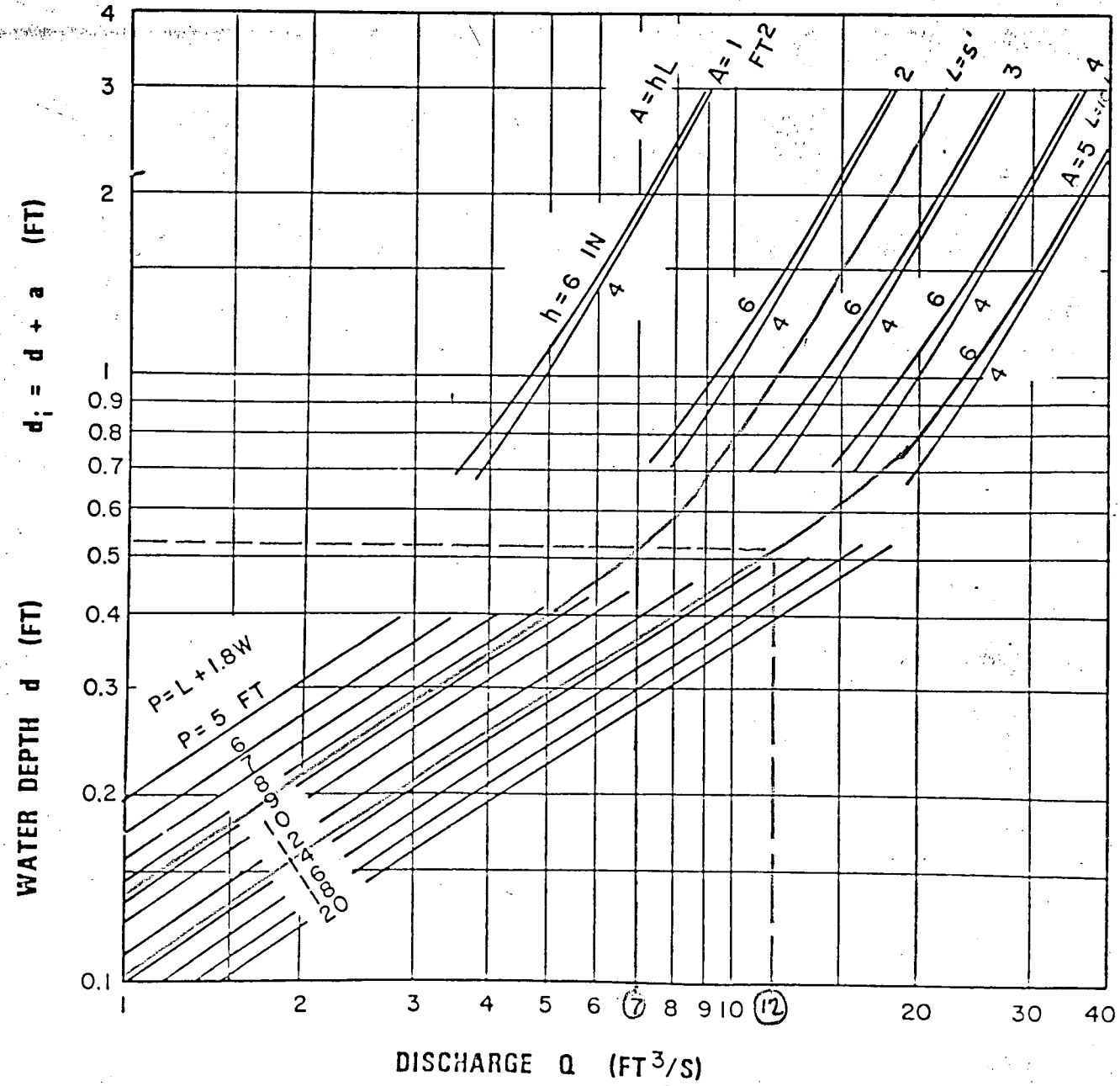
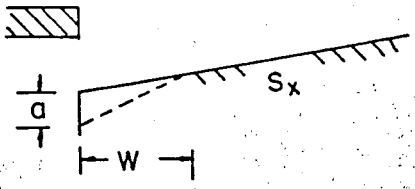


CHART 12. Depressed curb-opening inlet capacity in sump locations.

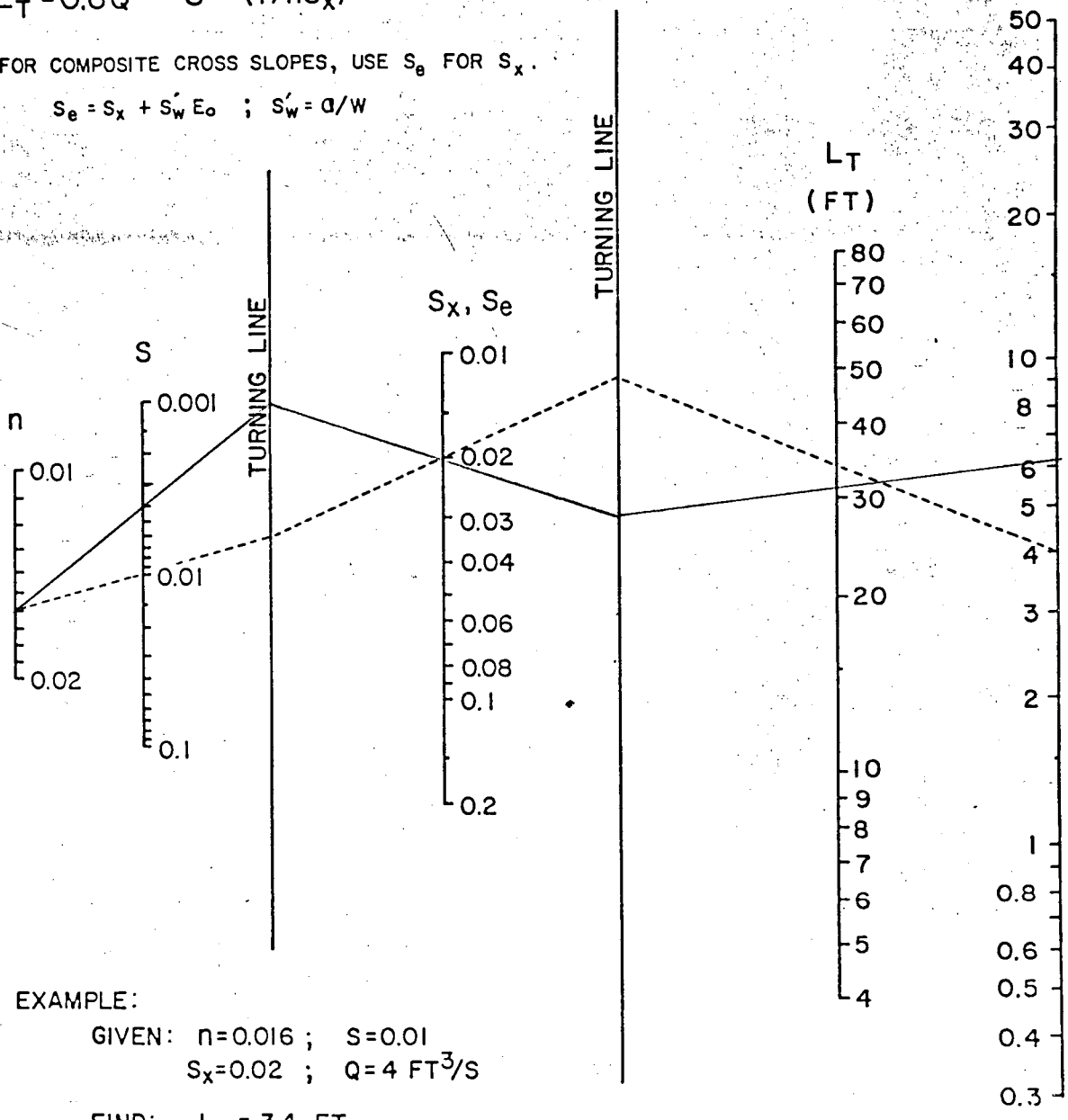
FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1984



$$L_T = 0.6 Q^{0.42} S^{0.3} (1/nS_x)^{0.6}$$

FOR COMPOSITE CROSS SLOPES, USE S_e FOR S_x.

$$S_e = S_x + S'_w E_o \quad ; \quad S'_w = a/W$$



EXAMPLE:

GIVEN: $n = 0.016$; $S = 0.01$
$S_x = 0.02$; $Q = 4\ FT^3/S$

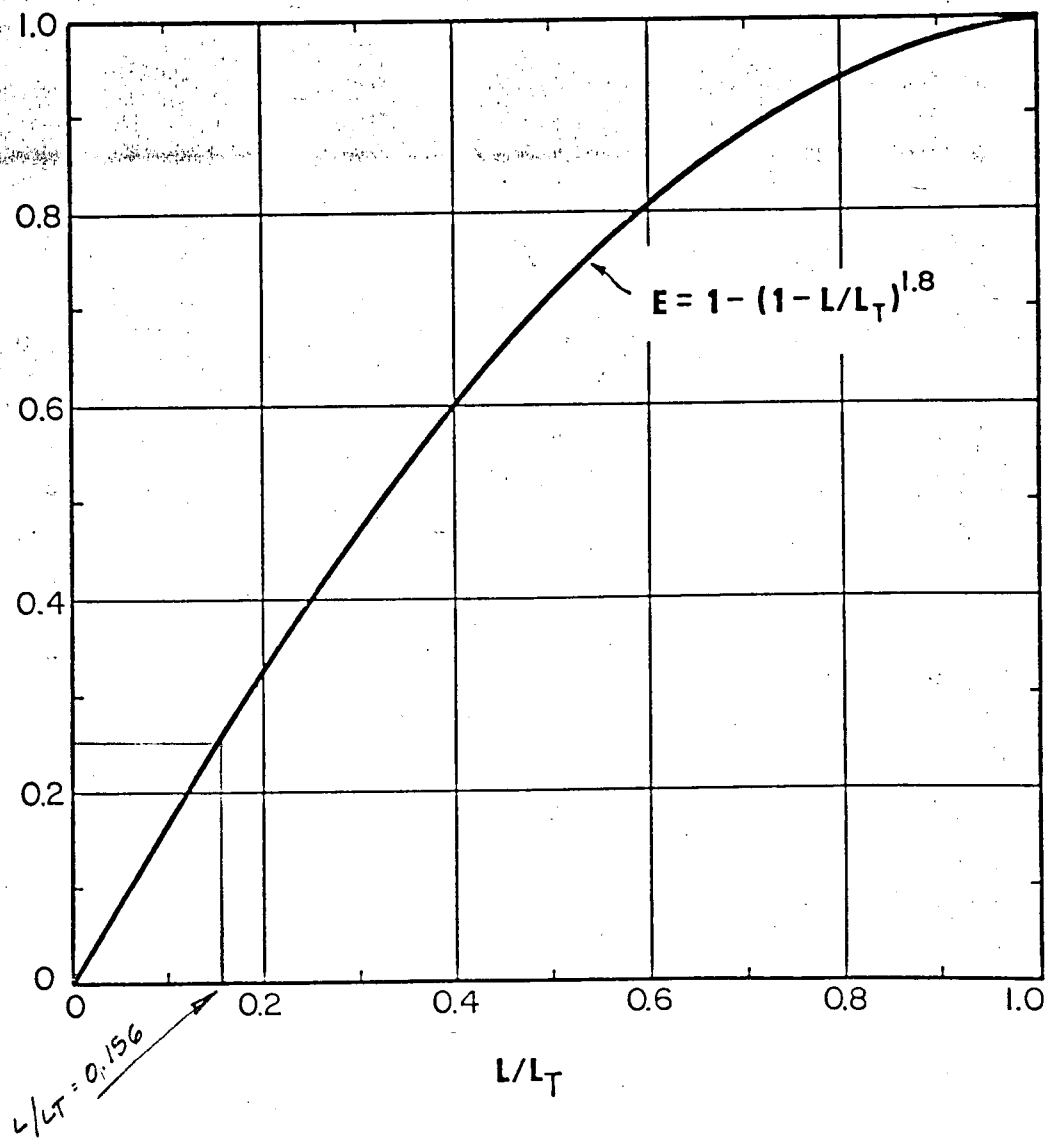
FIND: $L_T = 34$ FT

CHART 9. Curb-opening and slotted drain inlet length for total interception.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR. 1969.

For Node 908, $L = 5'$ $L_T = 32'$

$L/L_T = 5/32 = 0.156$



$E = 25\%$

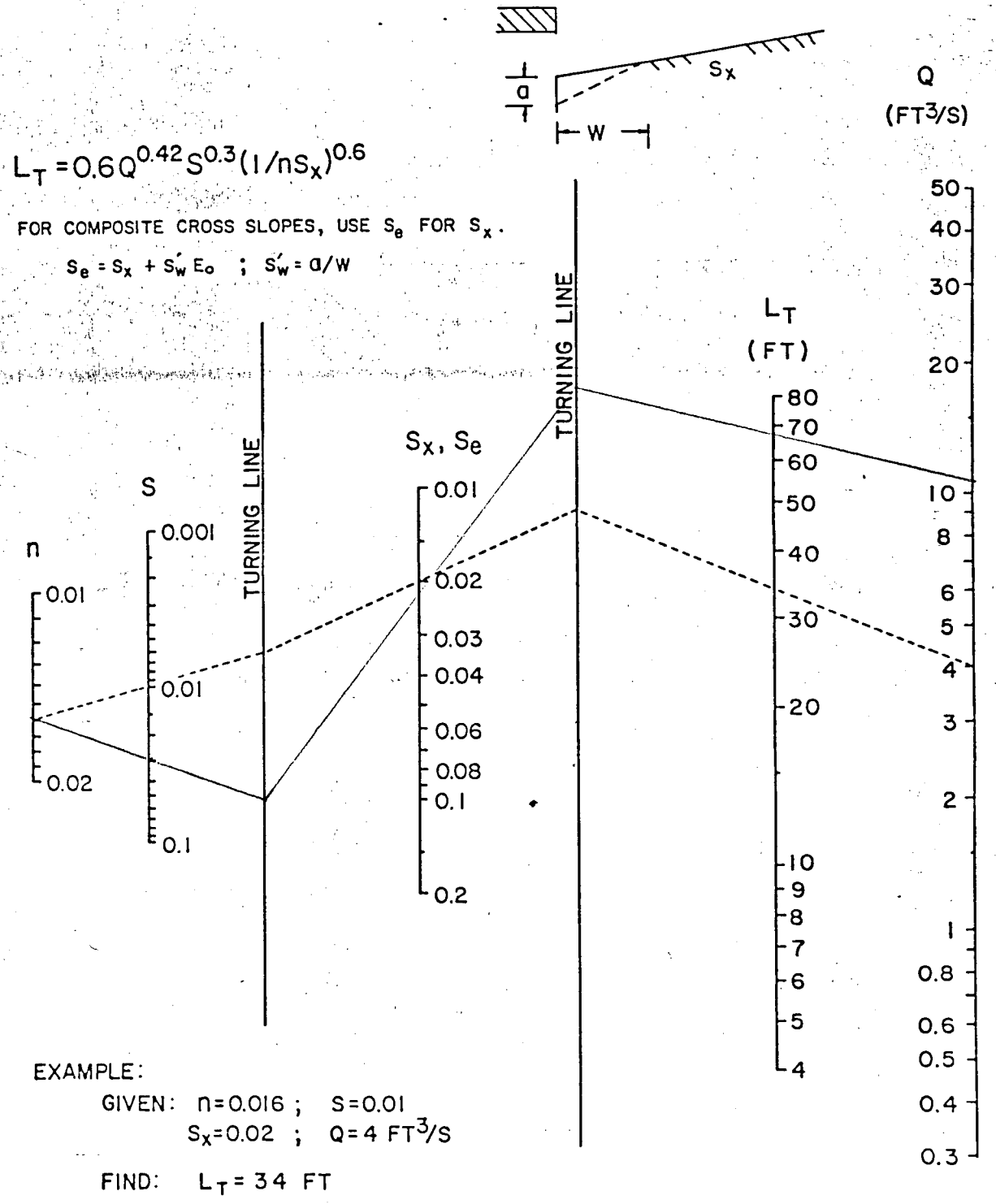
$Q_{approach} = 6.2$

$Q_i = 1.6$

$Q_b = 4.6$

CHART 10. Curb-opening and slotted drain inlet interception efficiency.

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



EXAMPLE:

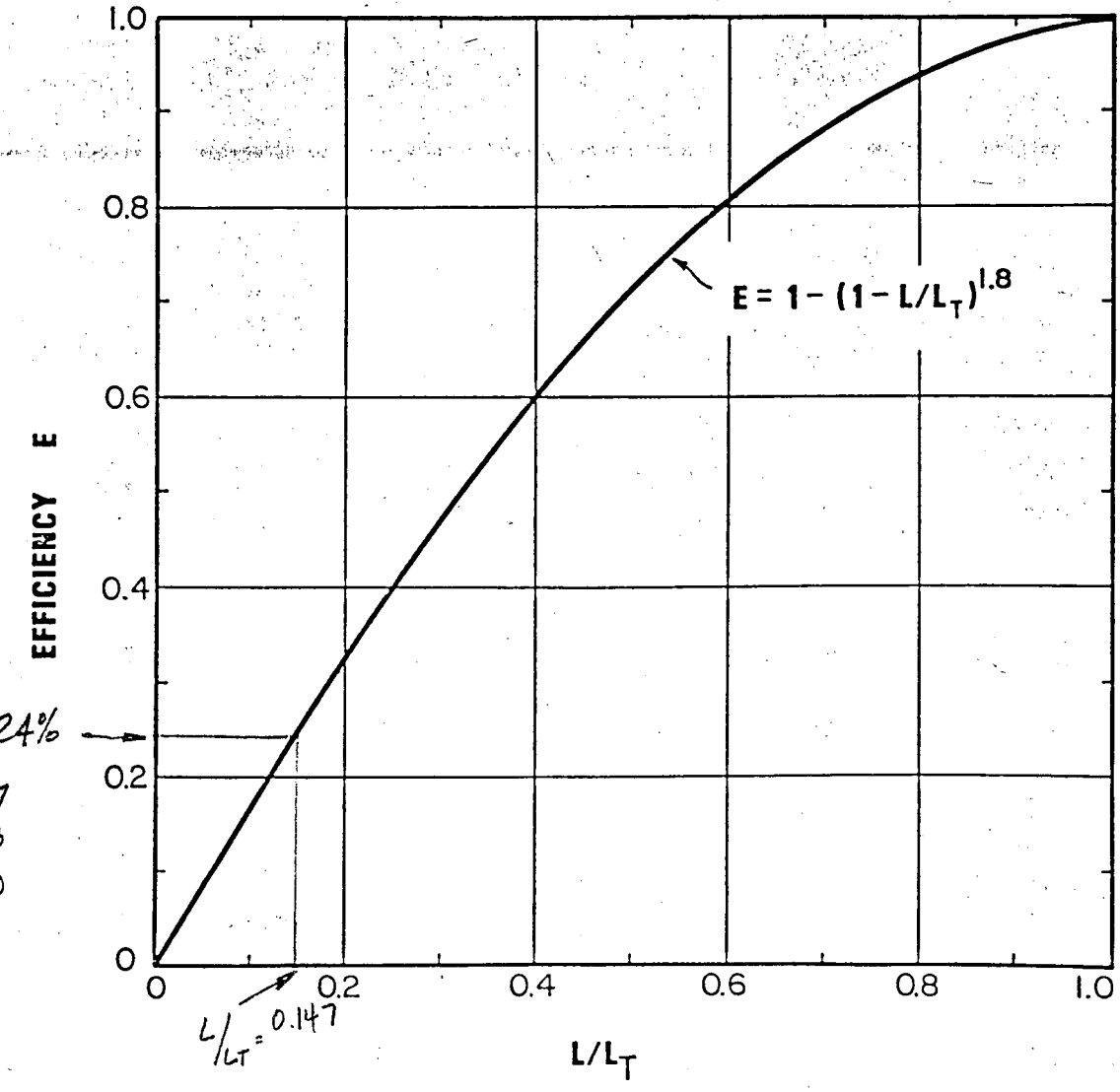
GIVEN: n=0.016 ; S=0.01
S_x=0.02 ; Q=4 FT^3/S

FIND: L_T = 34 FT

CHART 9. Curb-opening and slotted drain inlet length for total interception.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, FHWA, MAR. 1984

Node 906
L = 10'
L_T = 68'
L/L_T = 10/68 = 0.147



$Q_{approach}$ = 11.7
$Q_{int.}$ = 2.8
Q_{bypass} = 8.9

CHART 10. Curb-opening and slotted drain inlet interception efficiency.

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

```
100 j,  140.0000  900    3    9    8
110 t,golden hills 2nd addition
120 t,drainage plan
130 t,storm sewer system 900
140 i,  908      0.50      2.59      0.00      0.00      1.60      0.00    152.10
150 i,  907      0.50      6.46      0.00      0.00     12.00      0.00    152.10
160 i,  906      0.50      3.53      0.00      0.00      2.80      0.00    148.00
170 i,  905      0.50      1.34      0.00      0.00     12.10      0.00    147.20
180 i,  904      0.50      1.77      0.00      0.00      7.00      0.00    144.00
190 i,  903      0.50      4.84      0.00      0.00      7.00      0.00    144.50
200 i,  902      0.50      4.75      0.00      0.00     12.00      0.00    144.00
210 i,  901      0.50      0.56      0.00      0.00      6.90      0.00    143.60
220 j,  900    140.00
230 p,  908  907     38.00   15 0.013   90.00    0.00
240 p,  907  906    268.00   24 0.013    0.00    0.00
250 p,  905  906     30.00   18 0.013  135.00    0.00
260 p,  906  903    268.00   24 0.013    0.00    0.00
270 p,  903  902     91.00   30 0.013    0.00    0.00
280 p,  904  902     38.00   15 0.013   90.00    0.00
290 p,  902  901    170.00   36 0.013   65.00    0.00
300 p,  901  900     50.00   36 0.013    0.00    0.00
310 e
```

Date: 04-09-1986
Time: 12:05:41

Input File: golden2

golden hills 2nd addition
drainage plan
storm sewer system 900

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

Node	to Node	C	Tributary Area Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	Hydrology Summation TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Conduit Data Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
908	907	0.50	2.59	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	1.60	15"	1.30	38.00	0.49	0.49
907	906	0.50	6.46	0.00	0.0	0.00	0.00	0.00	0.49	15.47	0.00	13.60	24"	4.33	268.00	1.03	1.52
905	906	0.50	1.34	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	12.10	18"	6.85	30.00	0.07	0.07
906	903	0.50	3.53	0.00	0.0	0.00	0.00	0.00	1.52	9.92	0.00	20.11	24"	6.40	268.00	0.70	2.22
903	902	0.50	4.84	0.00	0.0	0.00	0.00	0.00	2.22	8.56	0.00	27.11	30"	5.52	91.00	0.27	2.49
904	902	0.50	1.77	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	7.00	15"	5.70	38.00	0.11	0.11
902	901	0.50	4.75	0.00	0.0	0.00	0.00	0.00	2.49	8.18	0.00	41.19	36"	5.83	170.00	0.49	2.98
901	900	0.50	0.56	0.00	0.0	0.00	0.00	0.00	2.98	7.63	0.00	48.09	36"	6.80	50.00	0.12	3.10

Date: 04-09-1986
Time: 12:05:41

Input File: golden2

golden hills 2nd addition
drainage plan
storm sewer system 900

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)
908	0.00041	0.0233	0.0000	0.0000	0.0000	0.0000	0.0000	0.0233	147.9324	152.1000	4.17
907	0.00341	0.9686	0.0000	0.0265	0.0000	0.0132	0.8194	1.8276	147.9090	152.1000	4.19
906	0.00790	2.1169	0.0000	0.0345	0.0000	0.0000	1.3002	3.4516	146.0814	148.0000	1.92
905	0.01327	0.3981	0.0000	0.0000	0.0000	0.0000	0.0000	0.3981	146.4795	147.2000	0.72
904	0.01174	0.4462	0.0000	0.0000	0.0000	0.0000	0.0000	0.4462	142.4530	144.0000	1.55
903	0.00437	0.3974	0.0000	0.0325	0.0000	0.0000	0.1930	0.6230	142.6298	144.5000	1.87
902	0.00381	0.6482	0.0000	0.0054	0.0000	0.0000	0.4896	1.1433	142.0068	144.0000	1.99
901	0.00520	0.2599	0.0000	0.0191	0.0000	0.1784	0.4061	0.8635	140.8635	143.6000	2.74
900	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	140.0000	140.0000	0.00

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Project Golden Hills 2nd Addition

Item Drainage Plan

CHECK DEPTH OF STREET FLOWS - 2-YR

NODE	Q_2*	street slope	X-slope	d#	Comment
908	6.2 cfs	0.40%	1/4 "/ft.	0.36'	OK - Std.
907	15.3 cfs				
	7.6 cfs (S)	0.40%	"	0.39'	OK Std
	7.6 cfs (W)	1.20%		0.30'	OK Roll
906	11.7 cfs				
	11.7 (S)	3.06%	"	0.30'	OK Std.
905	12.1 cfs				
	3.2 (W)	2.60%	"	0.20	OK Roll
	8.9 (S)	3.2% (around ret.)		0.27	OK Std
904	8.8 cfs				
	7.8 (S)	0.76%	"	0.34	OK Std
	1.0 (N)	0.38%		0.18	OK Std
903	11.5 cfs				
	4.0 (W)	2.50%	"	0.21	OK Roll
	7.5 (S)	0.76%		0.33	OK Std
902	15.8 cfs				
	1.0 (N)	0.38%	"	0.18	OK Std
	14.8 (S)	0.76%		0.42	OK Std.
901	6.9 cfs				
	3.4 (W)	0.32%	"	0.30'	OK Std
	3.5 (E)	0.36%		0.28'	OK Std.
900	—				

* From column 4, Page 3

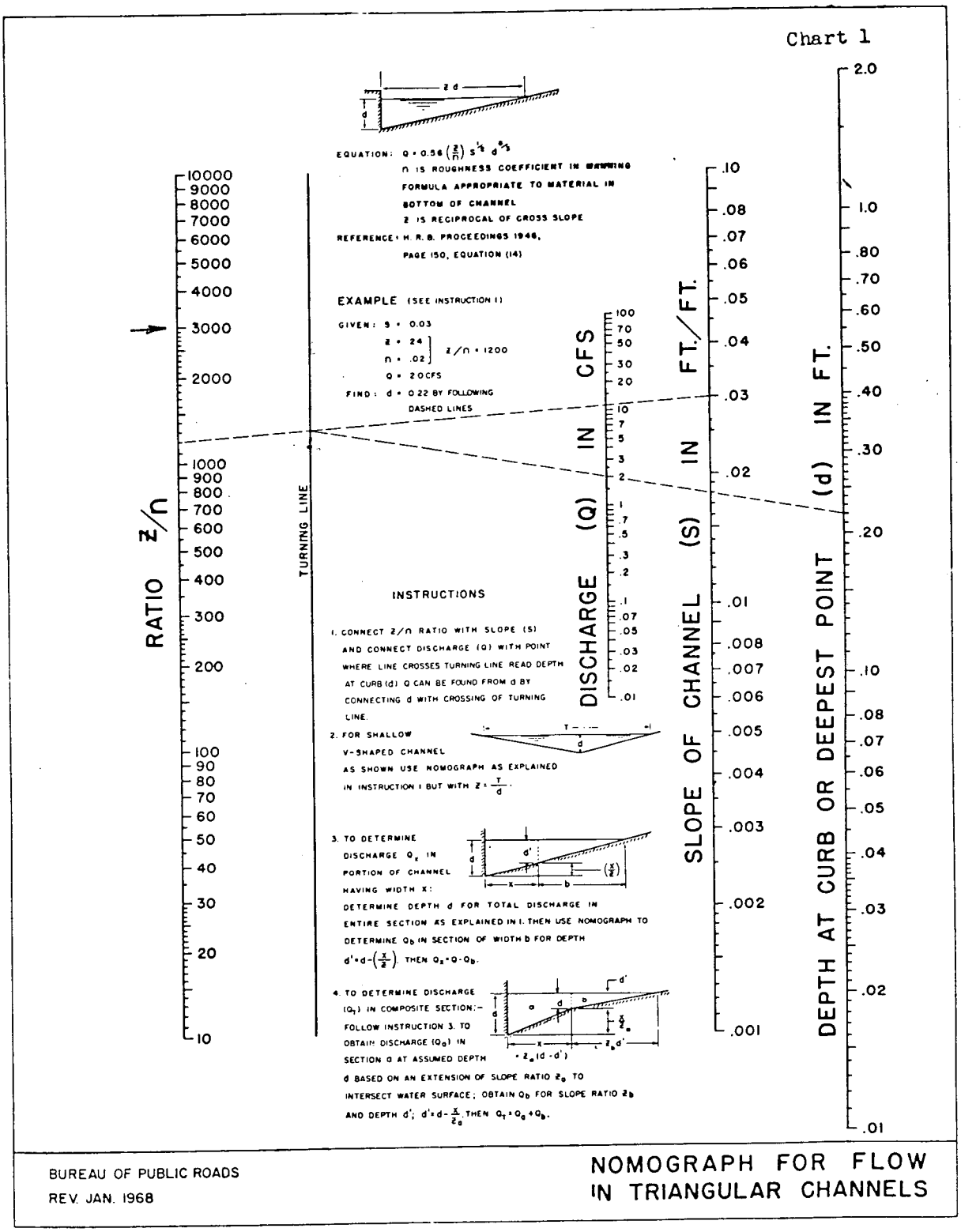
\# See chart, page 13

$n = 0.016$

$z = 1/1\frac{1}{4}" / ft = 48$

$\frac{z}{n} = \frac{48}{0.016} = 3000$

Chart 1



BUREAU OF PUBLIC ROADS
REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

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Project Golden Hills 2nd Addition

Item Drainage Plan

DETERMINE 100-YR DISCHARGES

Node	c *	t_c #	I_{100} *	A	Q_{100}
908	0.5	10	10.52	2.59	13.6
907	0.5	10	10.52	6.46	40.0
906	0.5	10	10.52	3.53	18.6
905	0.5	10	10.52	1.34	7.0
904	0.5	10	10.52	1.77	9.3
903	0.5	10	10.52	4.84	25.5
902	0.5	10	10.52	4.75	25.0
901	0.5	10	10.52	0.56	2.9
900	-				

* Average values used in Golden Hills 1st Add Drain. Plan

\# Assumed Value. Same values used in Golden Hills 1st Add'n Drainage Plan.

* From Weather Bureau Technical Paper No. 40.

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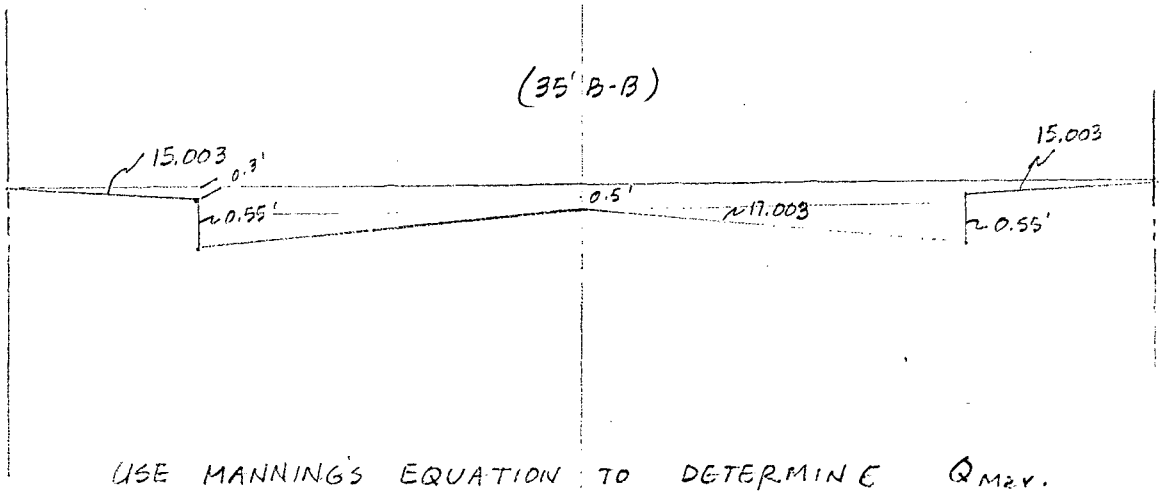
Item Drainage Plan.

CHECK STREET FLOW - 100 YR.

STREET FLOW = $Q_{100} - Q_2$

NODE(S)	Q_{100}	Q_{pipe}	Q_{street}	St. Slope	Q_{max}	Comments
		0	53.6	0.40%	72.5	OK +0.3 WK. Gd
908-907	13.6 + 40.0 = 53.6	13.6	40.0	3.10%	201.9	OK +0.3 WK. Gd
906-905	53.6 + 18.6 + 7.0 = 79.2	28.5	50.7	0.76%	100.0	OK +0.3 WK. Gd
902-903-904	79.2 + 9.3 + 125.5 + 125 + 2.3 = 137.0	54.5	82.5	0.36%	90.5	OK +0.4 WK. Gd
901-900	137.0	61.4	76.6	Overflow to Pond.		OK Overtop Curb



USE MANNING'S EQUATION TO DETERMINE Q_{MAX}.

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$ where n = roughness coeff.

A = Cross-Sectional Area.

R = Hydraulic Rad = A/Wetted Perim.

S = Longitudinal street slope.

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DETERMINE Q_{max}, WLK GD = +0.3' (Street Flow)

n = 29' @ 0.028 = 0.812 (lawn)
+ 36' @ 0.014 = 0.504 (concrete pav't)
1.316 ÷ 65 = 0.020

p = 2 @ 15.003 = 30.006
2 @ 0.55' = 1.100
2 @ 17.003 = 34.006
65.112'

A = 2 @ (1/2 × 15.0 × 0.3) = 4.50
2 @ (1/2 × 17.0 × 0.35') = 5.95
34' @ 0.5' = 17.00
27.45 S.F.

$R = A/p$ = 27.45 / 65.112 = 0.421581

$R^{2/3}$ = 0.562239

$Q_{max} = \frac{1.486}{0.020} \times 27.45 \times 0.562239 \times \sqrt{S}$ (Manning's Eq'n)

$Q_{max} = 1,146.7 \times \sqrt{S}$

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Project Golden Hills 2nd Add'n

Item Drainage Plan

DETERMINE Q_{max}, WK. GD. = +0.4' (Street Flow)

$n = 0.020$ (see page 16)

$P =$ 2 @ 15.005 = 30.01
2 @ 0.55 = 1.10
2 @ 17.003 = 34.006
65.116'

$A =$ 2 @ ($\frac{1}{2} \times 15 \times 0.4'$) = 6.00
2 @ ($\frac{1}{2} \times 17 \times 0.35$) = 5.95
34' x 0.6' = 20.40
32.35 □'

$R = A/P = 32.35/65.116 = 0.496806$

$R^{2/3} = (0.496806)^{2/3} = 0.627275$

$Q_{max} = \frac{1.486}{0.020} \times 32.35 \times 0.627275 \times \sqrt{S}$ (Manning's Eq'n)

$Q_{max} = 1507.7\sqrt{S}$

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Project Golden Hills 2nd

Item Drainage Plan - Detention Pond

Contour	Area □"	Area, Acres	Volume (Ac-Ft)	Σ Volume (Ac-Ft)
137	23.88	1.37	0	0
138	25.96	1.49	1.43	1.43
140	30.78	1.77	3.26	4.69

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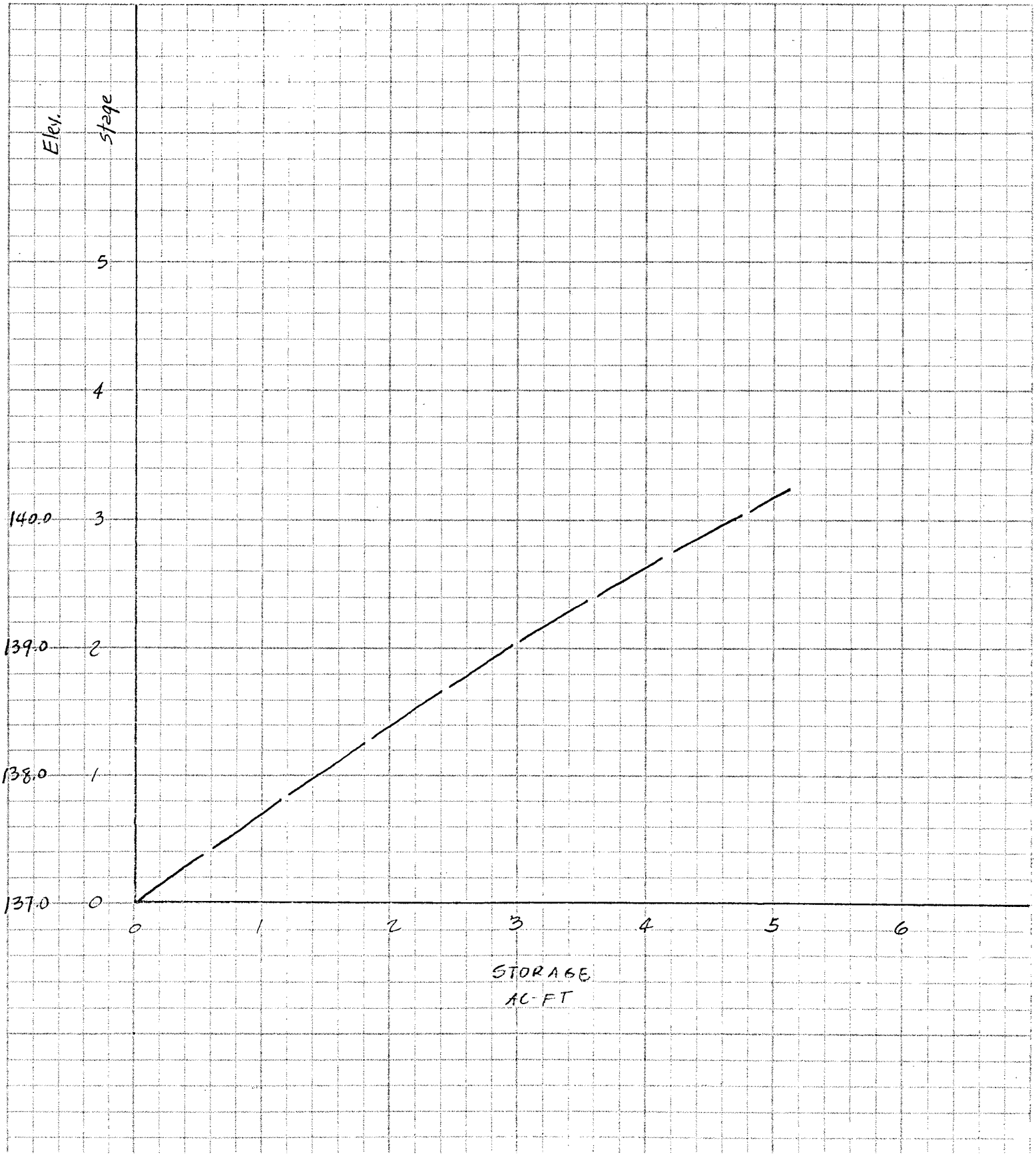
Project Golden Hills 2nd Add.

Item Detention Pond



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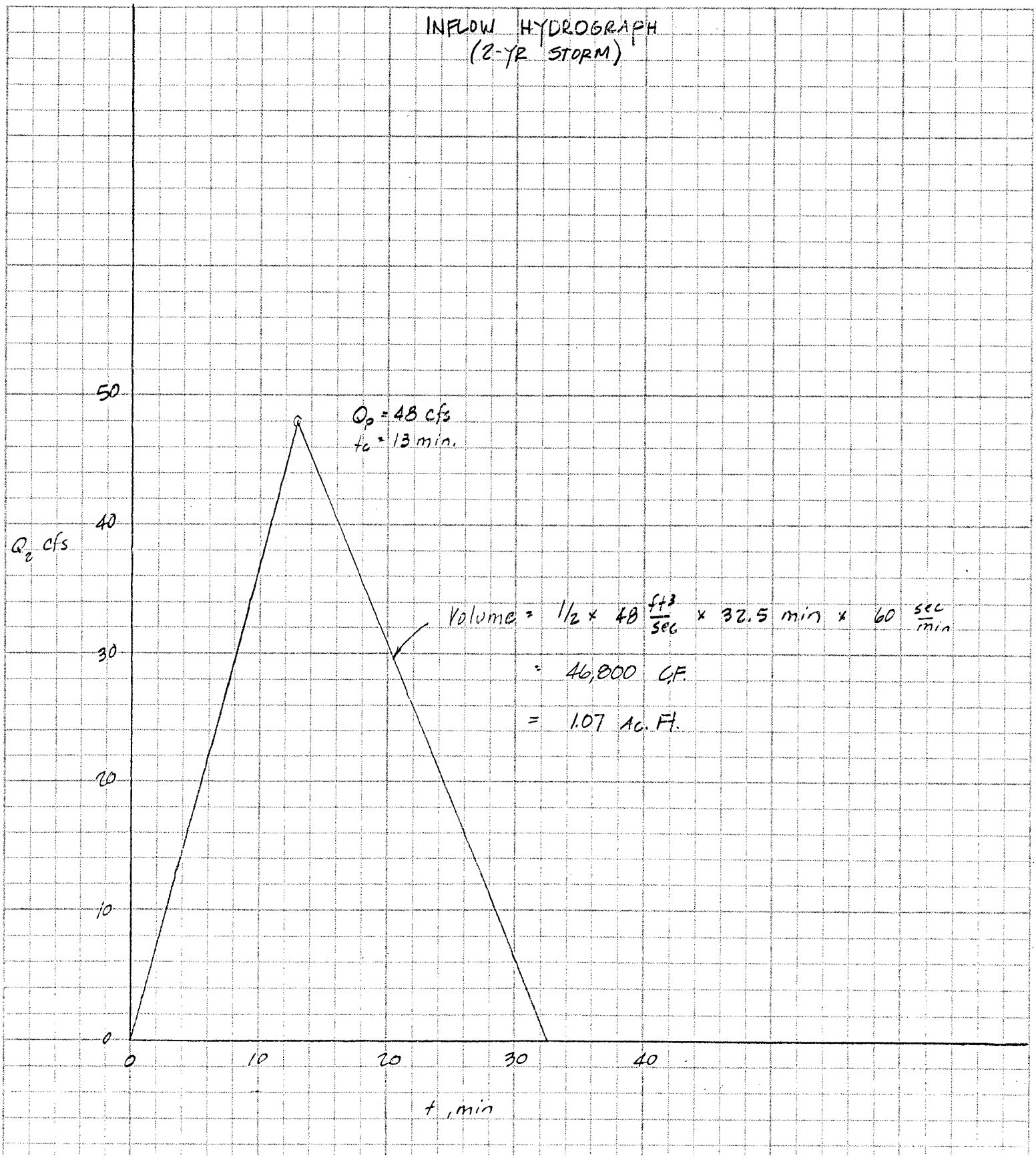
Project Golden Hills 2nd Add

Item Detention Pond

INFLOW HYDROGRAPH
(2-YR STORM)



Volume = $\frac{1}{2} \times 48 \frac{ft^3}{sec} \times 32.5 \text{ min} \times 60 \frac{sec}{min}$

= 46,800 C.F.

= 1.07 Ac. Ft.

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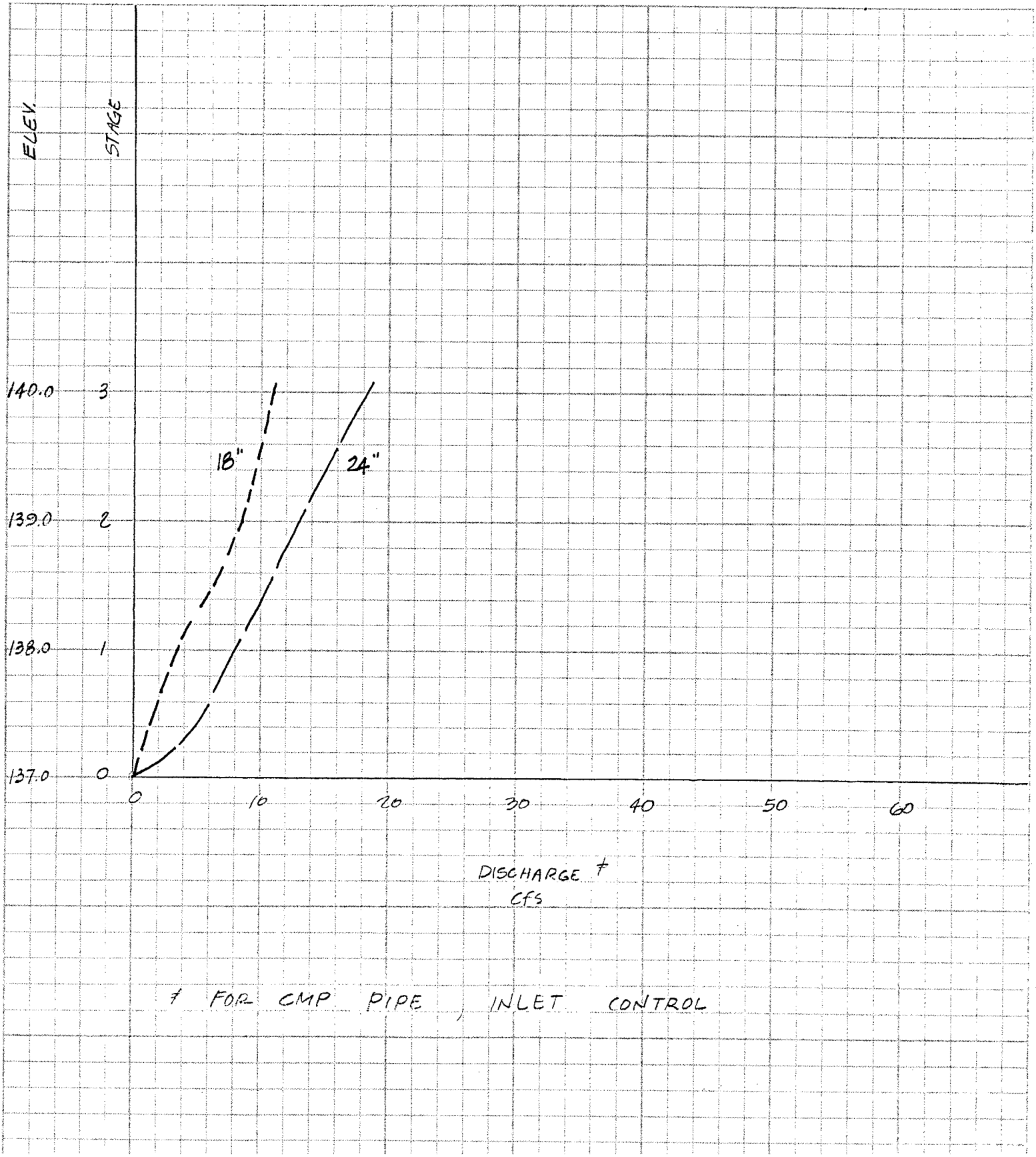
Item Defention Pond



* FOR CMP PIPE, INLET CONTROL

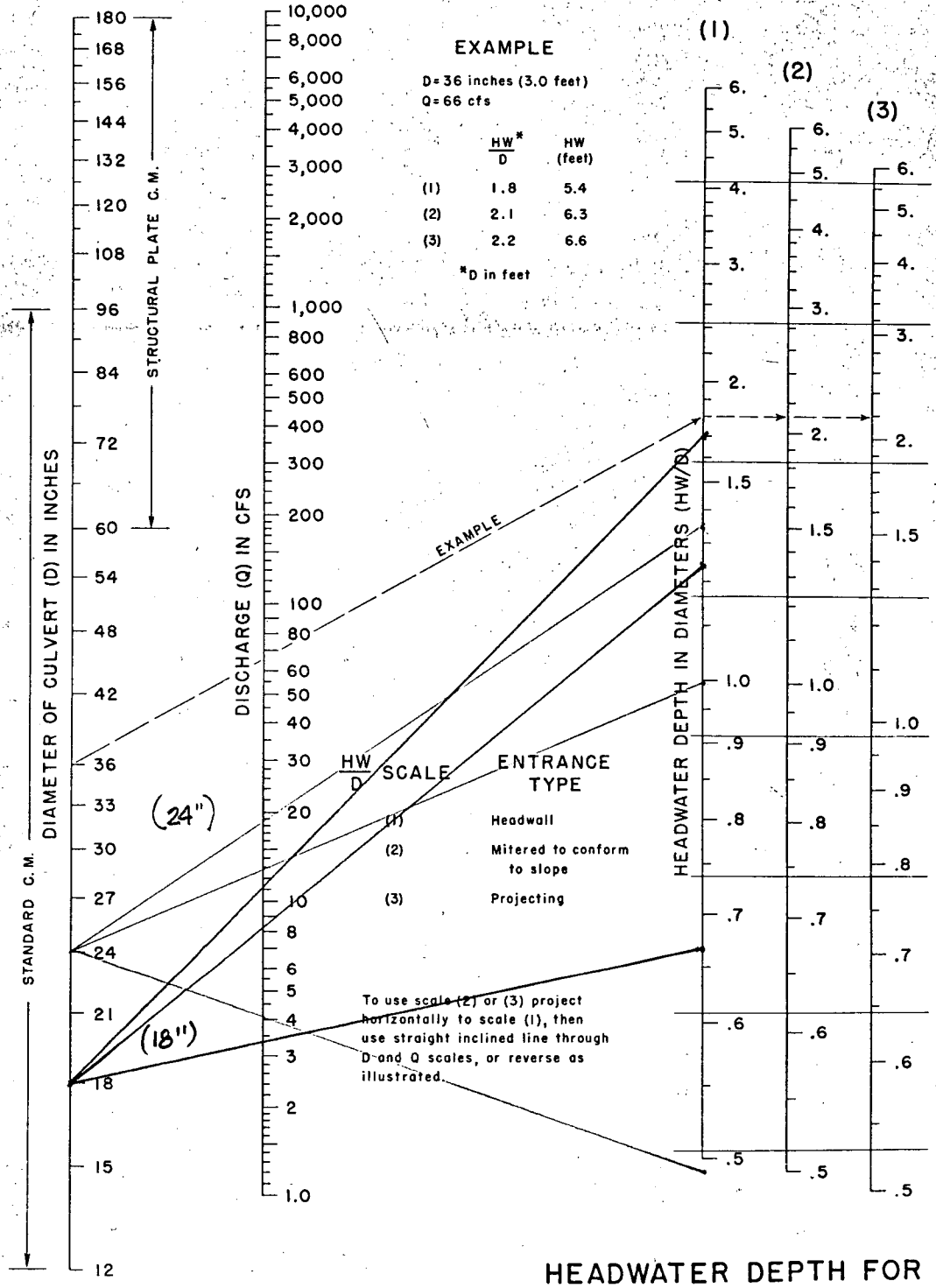
24"CMP

HW	HW/D	Q
1	0.5	4
2	1.0	13
3	1.5	18

18"CMP

HW	HW/D	Q
1	0.67	3.5
2	1.33	8.5
3	2.00	11.0

CHART 5



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

BUREAU OF PUBLIC ROADS JAN. 1963

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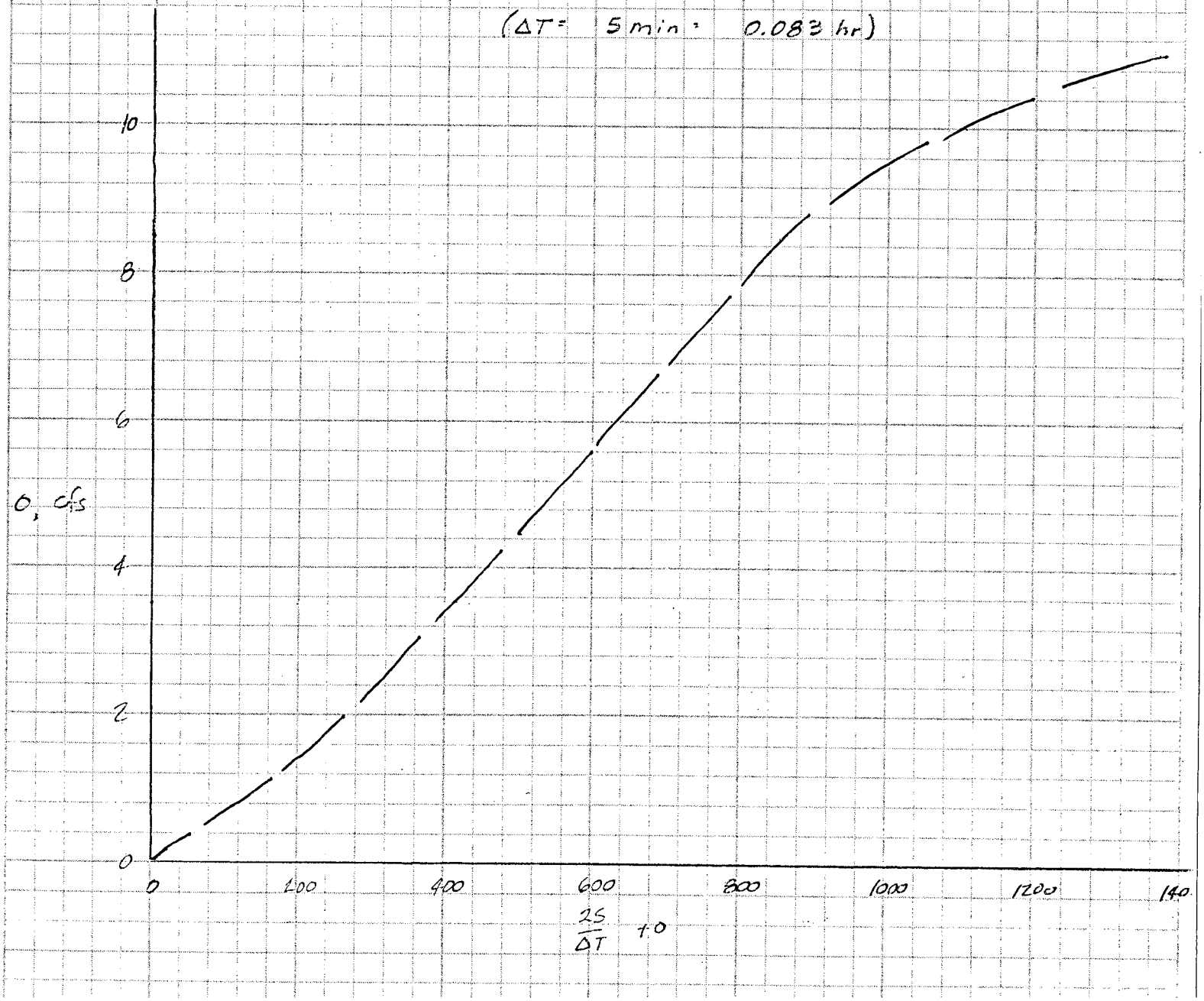
Item Detention Pond

STAGE	ELEV.	STORAGE (S) AC-FT	STORAGE (S) AC-IN	OUTFLOW	2S	2S/ΔT	2S/ΔT + O
0	137.0	0	0	0	0	0	0
1	138.0	1.43	17.16	3.5	34.32	413.5	417
2	139.0	2.93	35.16	8.5	70.32	847.2	856
3	140.0	4.69	56.28	11.0	112.56	1356.1	1367

(ΔT = 5 min = 0.083 hr)



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Item Defention Pond

Time (hr)	I_n (cfs)	$I_n + I_{n+1}$ (cfs)	$\frac{2S}{\Delta T} - O$	$\frac{2S}{\Delta T} + O$	O	HW		Elev.
0	0	18	0	0	0	0		137.0
0.083	18	55	18	18	0	0		137.0
0.167	37	85	71	73	1	0.5		137.5
0.25	48	79	154	156	1	0.5		137.5
0.33	31	50	229	233	2	0.7		137.7
0.416	19	25	275	279	2	0.7		137.7
0.50	6	6	296	300	2	0.7		137.7
0.583	0	0	298	302	2	0.7	PEAK	137.7
0.666	0	0	294	298	2	0.7		1377
0.750	0	0						
0.833	0	0						
0.917	0	0						
1.00	0	0						

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Item Defeution Pond

SUMMARY

Inflow Q_2 =	48.1 cfs		Volume Req'd =	1.07 Ac-Ft.
Outflow Q_2 =	2 cfs		Volume Avail =	4.69 Ac-Ft (to El. 140.0)
Static Pool =	137.0	City Datum		
Peak $Elev_2$ =	137.7	" "		
Outlet Pipe =	18" CMP			

Detention is not a requirement of plat, but is utilized to reduce outlet pipe size.