

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

DRAINAGE PLAN  
AND  
SUPPORTING CALCULATIONS  
FOR  
GOLDEN HILLS 4TH ADDITION  
AN ADDITION TO WICHITA, SEDGWICK COUNTY, KANSAS

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

MAY 22, 1987

**PROFESSIONAL  
ENGINEERING CONSULTANTS, PA**

1440 E. English  
WICHITA, KANSAS 67211

(316) 262-2691

TO Mr. Michael E. Lindebak, P.E.  
City Engineer

**LETTER OF TRANSMITTAL**

DATE	July 27, 1987	JOB NO.	36-86576-1310
ATTENTION	Ms. Vicky Huang		
RE:	Golden Hills 4th Addition		

WE ARE SENDING YOU  Attached  Under separate cover via \_\_\_\_\_ the following items:

- Shop drawings       Prints       Plans       Samples       Specifications  
 Copy of letter       Change order       \_\_\_\_\_

COPIES	DATE	NO.	DESCRIPTION
2	7-24-87		Golden Hills 4th Add. Revised Drainage Plan

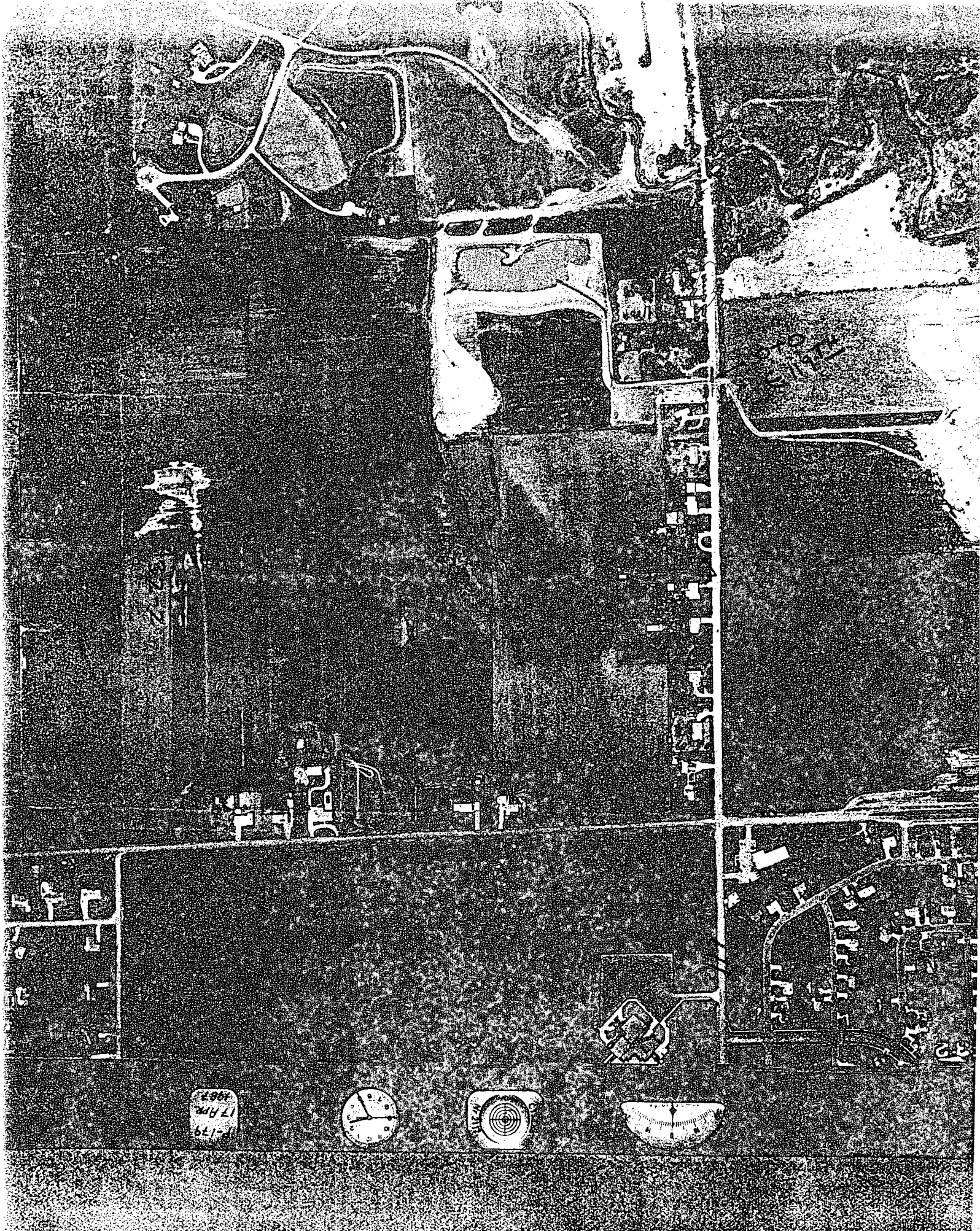
THESE ARE TRANSMITTED as checked below:

- For approval       Approved as submitted       Resubmit \_\_\_\_\_ copies for approval  
 For your use       Approved as noted       Submit \_\_\_\_\_ copies for distribution  
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 For review and comment       \_\_\_\_\_  
 FOR BIDS DUE \_\_\_\_\_ 19 \_\_\_\_\_       PRINTS RETURNED AFTER LOAN TO US

REMARKS This plan proposes that all runoff from Golden Hills 4th Addition be collected internally & discharged into existing ponds located west of 119th St. via storm sewers. and/or open channels.

COPY TO Mr. Bill Solt  
File

SIGNED: Charles Brown



1779

17 APR 1967



1779

17 APR 1967

Golden Hills 4th 36-86516

JOB NAME	Shadow Wood Lakes	CREW	DLS SF SL	DATE	July 9, 1987
JOB NO.	60-87233	WEATHER		TEMP.	
SEC.	T. R.	6th P.M.	INST.	BAR.	PPM

TITLE Profile - Drainage study PEC

B.M. #4			160.67	NE Cor. Porch 829 N. 119th St
0+00		158.9	168.9	E 119th St
0+14		158.7	168.7	TOP
0+24		156.4	166.4	⊥
0+31		158.8	168.8	TOP
0+50		158.9	168.9	
1+00		158.7	168.7	
1+50		158.1	168.1	
2+00		158.3	168.3	
2+50		158.4	168.4	
3+00		159.0	169.0	+
3+50		159.0	169.0	
4+00		158.8	163.8	
T.P.			161.55	NE CORN CONCRETE STEP to Const. Bldg
T.P.			161.55	
4+50		OK	159.1	PT. IN ROAD E-N
5+00			159.3	
5+25			159.2	
5+50			159.2	
6+50			159.2	
7+00			159.0	
7+50			157.6	
7+71			155.9	P.I. S-NW
T.P.			156.18	
T.P.			156.18	
8+00			155.3	
8+50			150.7	
9+00			146.5	
9+50			147.66	
T.P.			7.66	
T.P.			133.6	WATER EDGE
9+75				

100 j, 151.0000 900 3 19 18

110 t, golden hills fourth addition

120 t, drainage plan revision

130 t, system 900 analysis combination of 2- and 5-year storms

140 i, 918	0.55	7.26	0.00	0.00	16.20	10.00	159.40
150 i, 917	0.55	0.95	0.00	0.00	4.10	10.00	159.40
160 i, 916	0.80	1.39	0.00	0.00	8.90	5.00	158.50
170 i, 915	0.80	1.39	0.00	0.00	8.90	5.00	158.50
180 i, 914	0.70	1.07	0.00	0.00	4.60	10.00	158.20
190 i, 913	0.58	0.40	0.00	0.00	1.10	10.00	158.40
200 i, 912	0.55	1.31	0.00	0.00	2.80	16.00	158.20
210 i, 911	0.55	6.10	0.00	0.00	12.20	20.00	158.80
220 i, 910	0.52	6.90	0.00	0.00	12.90	21.00	158.10
230 i, 909	0.52	9.10	0.00	0.00	19.70	14.00	158.10
240 i, 908	0.52	1.20	0.00	0.00	2.70	13.00	158.00
250 i, 907	0.48	2.80	0.00	0.00	6.40	10.00	159.10
260 i, 906	0.48	2.50	0.00	0.00	5.60	10.00	159.10
270 m, 905	159.10						
280 i, 904	0.48	0.70	0.00	0.00	1.60	10.00	159.10
290 i, 903	0.48	1.60	0.00	0.00	3.60	10.00	159.10
300 m, 902	159.60						
310 m, 901	159.60						
320 m, 900	151.00						

330 p, 918 917	40.00	24	0.013	90.00	0.00
340 p, 917 914	320.00	30	0.013	80.00	0.00
350 p, 916 915	160.00	24	0.013	90.00	0.00
360 p, 915 914	200.00	30	0.013	10.00	0.00
370 p, 914 912	40.00	36	0.013	10.00	0.00
380 p, 913 912	70.00	15	0.013	90.00	0.00
390 p, 912 911	210.00	42	0.013	0.00	0.00
400 p, 911 910	260.00	42	0.013	45.00	0.00
410 p, 909 910	80.00	24	0.013	135.00	0.00
420 p, 910 908	60.00	54	0.013	45.00	0.00
430 p, 908 905	790.00	54	0.013	30.00	0.00
440 p, 907 905	80.00	15	0.013	60.00	0.00
450 p, 904 905	10.00	15	0.013	130.00	0.00
460 p, 905 903	50.00	54	0.013	60.00	0.00
470 p, 906 903	90.00	15	0.013	0.00	0.00
480 p, 903 902	120.00	54	0.013	90.00	0.00
490 p, 902 901	70.00	54	0.013	90.00	0.00
500 p, 901 900	100.00	54	0.013	0.00	0.00
510 e					

Input File: goldalt

golden hills fourth addition  
drainage plan revision  
system 900 analysis combination of 2- and 5-year storms

Storm Frequency = 2-Year

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

*****												*****											
Tributary Area							Hydrology Summation					Conduit Data											
*****												*****											
Node to	C	Area	Slope	Length	TC(θ)	I(θ)	Q(θ)	TC	I	Q	Sum Q	Size	Velocity	Length	TT	TT+TC							
Node		(Ac)	(%)	(Ft)	(Min)	(In/Hr)	(CFS)	(Min)	(In/Hr)	(CFS)	(CFS)		(Ft/Sec)	(Ft)	(Min)	(Min)							
*****												*****											
918	917	0.55	7.26	0.00	0.0	10.00	4.75	16.20	10.00	4.75	16.20	16.20	24"	5.16	40.00	0.13	10.13						
917	914	0.55	0.95	0.00	0.0	10.00	4.75	4.10	10.13	4.73	4.08	20.28	30"	4.13	320.00	1.29	11.42						
916	915	0.80	1.39	0.00	0.0	5.00	6.23	8.90	5.00	6.23	8.90	8.90	24"	2.83	160.00	0.94	5.94						
915	914	0.80	1.39	0.00	0.0	5.00	6.23	8.90	5.94	5.82	8.32	17.22	30"	3.51	200.00	0.95	6.89						
914	912	0.70	1.07	0.00	0.0	10.00	4.75	4.60	11.42	4.51	4.37	39.79	36"	5.49	40.00	0.12	11.54						
913	912	0.58	0.40	0.00	0.0	10.00	4.75	1.10	10.00	4.75	1.10	1.10	15"	0.90	70.00	1.30	11.30						
912	911	0.55	1.31	0.00	0.0	16.00	3.96	2.80	11.54	4.50	2.02	41.90	42"	4.35	210.00	0.80	12.35						
911	910	0.55	6.10	0.00	0.0	20.00	3.63	12.20	12.35	4.38	7.53	49.43	42"	5.14	260.00	0.84	13.19						
909	910	0.52	9.10	0.00	0.0	14.00	4.17	19.70	14.00	4.17	19.70	19.70	24"	6.27	80.00	0.21	14.21						
910	908	0.52	5.90	0.00	0.0	21.00	3.56	12.90	13.19	4.27	8.10	75.81	54"	4.77	60.00	0.21	13.40						
908	905	0.52	1.20	0.00	0.0	13.00	4.29	2.70	13.40	4.24	2.67	78.48	54"	4.93	790.00	2.67	16.07						
907	905	0.48	2.80	0.00	0.0	10.00	4.75	6.40	10.00	4.75	6.40	6.40	15"	5.22	80.00	0.26	10.26						
904	905	0.48	0.70	0.00	0.0	10.00	4.75	1.60	10.00	4.75	1.60	1.60	15"	1.30	10.00	0.13	10.13						
905	903	0.00	0.00	0.00	0.0	0.00	0.00	0.00	16.07	3.95	0.00	85.19	54"	5.36	50.00	0.16	16.22						
906	903	0.48	2.50	0.00	0.0	10.00	4.75	5.60	10.00	4.75	5.60	5.60	15"	4.56	90.00	0.33	10.33						
903	902	0.48	1.60	0.00	0.0	10.00	4.75	3.60	16.22	3.94	2.90	92.87	54"	5.84	120.00	0.34	16.56						
902	901	0.00	0.00	0.00	0.0	0.00	0.00	0.00	16.56	3.90	0.00	92.87	54"	5.84	70.00	0.20	16.76						
901	900	0.00	0.00	0.00	0.0	0.00	0.00	0.00	16.76	3.89	0.00	92.87	54"	5.84	100.00	0.29	17.05						
*****												*****											

Input File: goldalt

golden hills fourth addition  
 drainage plan revision  
 system 900 analysis combination of 2- and 5-year storms

Storm Frequency = 2-Year

\* \* \* HYDRAULICS \* \* \*

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Node   Hyd-Slope  Friction  Bend  Transition  Manhole  Deflection  Junction  Total  Hyd-GI  Desired  Diff.
      (Ft/Ft)   (Ft)     (Ft)   (Ft)        (Ft)     (Ft)       (Ft)     (Ft)   Elevation Elevation (Ft)
*****
918    0.00513   0.2051   0.0000  0.0000     0.0000   0.0000    0.0000   0.2051  157.9471  159.4000  1.45
917    0.00244   0.7822   0.0000  0.0296     0.0000   0.2064    0.0200   1.0391  157.7420  159.4000  1.66
916    0.00155   0.2476   0.0000  0.0000     0.0000   0.0000    0.0000   0.2476  157.6524  158.5000  0.85
915    0.00176   0.3525   0.0000  0.0066     0.0000   0.0623    0.2804   0.7019  157.4047  158.5000  1.10
914    0.00330   0.1353   0.0000  0.0203     0.0000   0.1150    0.3761   0.6466  156.7029  158.2000  1.50
913    0.00029   0.0203   0.0000  0.0000     0.0000   0.0000    0.0000   0.0203  156.0765  158.4000  2.32
912    0.00173   0.3642   0.0000  0.0346     0.0000   0.0167   -0.1005   0.3151  156.0562  158.2000  2.14
911    0.00241   0.6276   0.0000  0.0115     0.0000   0.0000    0.2416   0.8007  155.7411  158.8000  3.06
910    0.00149   0.0892   0.0000  0.0114     0.0000   0.0092    0.4046   0.6744  154.8604  158.1000  3.24
909    0.00750   0.6067   0.0000  0.0000     0.0000   0.0000    0.0000   0.6067  155.4671  158.1000  2.63
908    0.00159   1.2583   0.0000  0.0025     0.0000   0.0768    0.0584   1.3960  154.1860  158.0000  3.81
907    0.00982   0.7853   0.0000  0.0000     0.0000   0.0000    0.0000   0.7853  153.5753  159.1000  5.52
906    0.00752   0.6764   0.0000  0.0000     0.0000   0.0000    0.0000   0.6764  153.2016  159.1000  5.90
905    0.00180   0.0938   0.0000  0.0067     0.0000   0.0506    0.1137   0.2649  152.7901  159.1000  6.31
904    0.00061   0.0061   0.0000  0.0000     0.0000   0.0000    0.0000   0.0061  152.7962  159.1000  6.30
903    0.00223   0.2676   0.0000  0.0084     0.0000   0.1369    0.1284   0.5414  152.5252  159.1000  6.57
902    0.00223   0.1561   0.0000  0.0000     0.0265   0.2647    0.0112   0.4585  151.9838  159.6000  7.62
901    0.00223   0.2233   0.0000  0.0000     0.0265   0.2647    0.0112   0.5254  151.5254  159.6000  8.07
900    0.00000   0.0000   0.0000  0.0000     0.0000   0.0000    0.0000   0.0000  151.0000  151.0000  0.00
*****

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100 j, 151.0000 900 3 19 18

110 t, golden hills fourth addition

120 t, drainage plan revision

130 t, system 900 analysis combination of 2- and 5-year storms

140 i, 918	0.55	7.26	0.00	0.00	16.20	10.00	159.40
150 i, 917	0.55	0.95	0.00	0.00	4.10	10.00	159.40
160 i, 916	0.80	1.39	0.00	0.00	8.90	5.00	158.50
170 i, 915	0.80	1.39	0.00	0.00	8.90	5.00	158.50
180 i, 914	0.70	1.07	0.00	0.00	4.60	10.00	158.20
190 i, 913	0.58	0.40	0.00	0.00	1.10	10.00	158.40
200 i, 912	0.55	1.31	0.00	0.00	2.80	16.00	158.20
210 i, 911	0.55	6.10	0.00	0.00	12.20	20.00	158.80
220 i, 910	0.52	6.90	0.00	0.00	12.90	21.00	158.10
230 i, 909	0.52	9.10	0.00	0.00	19.70	14.00	158.10
240 i, 908	0.52	1.20	0.00	0.00	2.70	13.00	158.00
250 i, 907	0.48	2.80	0.00	0.00	6.40	10.00	159.10
260 i, 906	0.48	2.50	0.00	0.00	5.60	10.00	159.10
270 m, 905	159.10						
280 i, 904	0.48	0.70	0.00	0.00	1.60	10.00	159.10
290 i, 903	0.48	1.60	0.00	0.00	3.60	10.00	159.10
300 m, 902	159.60						
310 m, 901	159.60						
320 m, 900	151.00						
330 p, 918 917	40.00	24 0.013	90.00	0.00			
340 p, 917 914	320.00	30 0.013	80.00	0.00			
350 p, 916 915	160.00	24 0.013	90.00	0.00			
360 p, 915 914	200.00	30 0.013	10.00	0.00			
370 p, 914 912	40.00	36 0.013	10.00	0.00			
380 p, 913 912	70.00	15 0.013	90.00	0.00			
390 p, 912 911	210.00	42 0.013	0.00	0.00			
400 p, 911 910	260.00	42 0.013	45.00	0.00			
410 p, 909 910	80.00	24 0.013	135.00	0.00			
420 p, 910 908	60.00	54 0.013	45.00	0.00			
430 p, 908 905	790.00	54 0.013	30.00	0.00			
440 p, 907 905	80.00	15 0.013	60.00	0.00			
450 p, 904 905	10.00	15 0.013	130.00	0.00			
460 p, 905 903	50.00	54 0.013	60.00	0.00			
470 p, 906 903	90.00	15 0.013	0.00	0.00			
480 p, 903 902	120.00	54 0.013	90.00	0.00			
490 p, 902 901	70.00	54 0.013	90.00	0.00			
500 p, 901 900	100.00	54 0.013	0.00	0.00			
510 e							

Input File: goldalt

golden hills fourth addition  
drainage plan revision  
system 900 analysis combination of 2- and 5-year storms

Storm Frequency = 2-Year

\* \* \* HYDROLOGY \* \* \*

Tributary Area										Hydrology Summation				Conduit Data			
Node to	C	Area	Slope	Length	TC(0)	I(0)	Q(0)	TC	I	Q	Sum Q	Size	Velocity	Length	TT	TT+TC	
Node		(Ac)	(%)	(Ft)	(Min)	(In/Hr)	(CFS)	(Min)	(In/Hr)	(CFS)	(CFS)		(Ft/Sec)	(Ft)	(Min)	(Min)	
918	917	0.55	7.26	0.00	0.0	10.00	4.75	16.20	10.00	4.75	16.20	16.20	24"	5.16	40.00	0.13	10.13
917	914	0.55	0.95	0.00	0.0	10.00	4.75	4.10	10.13	4.73	4.08	20.28	30"	4.13	320.00	1.29	11.42
916	915	0.80	1.39	0.00	0.0	5.00	6.23	8.90	5.00	6.23	8.90	8.90	24"	2.83	160.00	0.94	5.94
915	914	0.80	1.39	0.00	0.0	5.00	6.23	8.90	5.94	5.82	8.32	17.22	30"	3.51	200.00	0.95	6.89
914	912	0.70	1.07	0.00	0.0	10.00	4.75	4.60	11.42	4.51	4.37	38.79	36"	5.49	40.00	0.12	11.54
913	912	0.58	0.40	0.00	0.0	10.00	4.75	1.10	10.00	4.75	1.10	1.10	15"	0.90	70.00	1.30	11.30
912	911	0.55	1.31	0.00	0.0	16.00	3.96	2.80	11.54	4.50	2.02	41.90	42"	4.35	210.00	0.80	12.35
911	910	0.55	6.10	0.00	0.0	20.00	3.63	12.20	12.35	4.38	7.53	49.43	42"	5.14	260.00	0.84	13.19
909	910	0.52	9.10	0.00	0.0	14.00	4.17	19.70	14.00	4.17	19.70	19.70	24"	6.27	80.00	0.21	14.21
910	908	0.52	6.90	0.00	0.0	21.00	3.56	12.90	13.19	4.27	8.10	75.81	54"	4.77	60.00	0.21	13.40
908	905	0.52	1.20	0.00	0.0	13.00	4.29	2.70	13.40	4.24	2.67	78.48	54"	4.93	790.00	2.67	16.07
907	905	0.48	2.80	0.00	0.0	10.00	4.75	6.40	10.00	4.75	6.40	6.40	15"	5.22	80.00	0.26	10.26
904	905	0.48	0.70	0.00	0.0	10.00	4.75	1.60	10.00	4.75	1.60	1.60	15"	1.30	10.00	0.13	10.13
905	903	0.00	0.00	0.00	0.0	0.00	0.00	0.00	16.07	3.95	0.00	85.19	54"	5.36	50.00	0.16	16.22
906	903	0.48	2.50	0.00	0.0	10.00	4.75	5.60	10.00	4.75	5.60	5.60	15"	4.56	90.00	0.33	10.33
903	902	0.48	1.60	0.00	0.0	10.00	4.75	3.60	16.22	3.94	2.98	92.87	54"	5.84	120.00	0.34	16.56
902	901	0.00	0.00	0.00	0.0	0.00	0.00	0.00	16.56	3.90	0.00	92.87	54"	5.84	70.00	0.20	16.76
901	900	0.00	0.00	0.00	0.0	0.00	0.00	0.00	16.76	3.89	0.00	92.87	54"	5.84	100.00	0.29	17.05

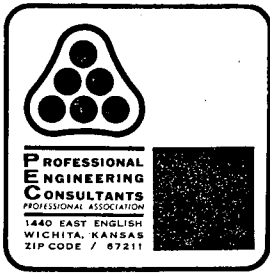
Input File: goldalt

golden hills fourth addition  
drainage plan revision  
system 900 analysis combination of 2- and 5-year storms

Storm Frequency = 2-Year

\* \* \* HYDRAULICS \* \* \*

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Revd (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
918	0.00513	0.2051	0.0000	0.0000	0.0000	0.0000	0.0000	0.2051	157.9471	159.4000	1.45
917	0.00244	0.7822	0.0000	0.0296	0.0000	0.2064	0.0208	1.0391	157.7420	159.4000	1.66
916	0.00155	0.2476	0.0000	0.0000	0.0000	0.0000	0.0000	0.2476	157.6524	158.5000	0.85
915	0.00176	0.3525	0.0000	0.0066	0.0000	0.0623	0.2804	0.7019	157.4047	158.5000	1.10
914	0.00338	0.1353	0.0000	0.0203	0.0000	0.1150	0.3761	0.6466	156.7029	158.2000	1.50
913	0.00029	0.0203	0.0000	0.0000	0.0000	0.0000	0.0000	0.0203	156.0765	158.4000	2.32
912	0.00173	0.3642	0.0000	0.0346	0.0000	0.0167	-0.1005	0.3151	156.0562	158.2000	2.14
911	0.00241	0.6276	0.0000	0.0115	0.0000	0.0000	0.2416	0.8807	155.7411	158.0000	3.06
910	0.00149	0.0892	0.0000	0.0114	0.0000	0.0892	0.4046	0.6744	154.8604	158.1000	3.24
909	0.00758	0.6067	0.0000	0.0000	0.0000	0.0000	0.0000	0.6067	155.4671	158.1000	2.63
908	0.00159	1.2583	0.0000	0.0025	0.0000	0.0768	0.0584	1.3960	154.1860	158.0000	3.81
907	0.00982	0.7853	0.0000	0.0000	0.0000	0.0000	0.0000	0.7853	153.5753	159.1000	5.52
906	0.00752	0.6764	0.0000	0.0000	0.0000	0.0000	0.0000	0.6764	153.2016	159.1000	3.90
905	0.00138	0.0938	0.0000	0.0067	0.0000	0.0506	0.1137	0.2649	152.7901	159.1000	6.31
904	0.00061	0.0061	0.0000	0.0000	0.0000	0.0000	0.0000	0.0061	152.7962	159.1000	6.30
903	0.00223	0.2676	0.0000	0.0084	0.0000	0.1369	0.1284	0.5414	152.5252	159.1000	6.57
902	0.00223	0.1561	0.0000	0.0000	0.0265	0.2647	0.0112	0.4585	151.9238	159.6000	7.62
901	0.00223	0.2230	0.0000	0.0000	0.0265	0.2647	0.0112	0.5254	151.5254	159.6000	8.07
900	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	151.0000	151.0000	0.00



Date May 20, 1987 Page 1 of       

Project Golden Hills 4th Addition

Item Drainage Plan -- 2yr.

HYDROLOGY

Use Rational Formula  $Q = CIA$

Since Golden Hills 4th was included in original Golden Hills Drainage Plan, use criteria that was used on original study

$t_c$  min = 10 min. (residential) 5 min (business)

I = Tech Paper 40

Determine "c"

<u>Node</u>	<u>Land Use</u>	<u>Soil</u>	<u>Lot Size</u>	<u>C</u>
416	Starting Point	on Future system		
415	Business - Neighborhood	-	-	0.69
414	Res.	50% C 50% D	2 1/8 Ac.	0.55
413	Business - Neighborhood	-	-	0.69
412	Res	D	1/8 Ac.	0.55
411	Exist Past.	D.	N/A	0.40
410	(Manhole)	-	-	-
409	Business - Neigh.	-	-	0.69
408	Res	D	1/8 Ac.	0.55
407	Res	C	1/8 Ac	0.55
406	Res	C	1/8 Ac.	0.55



Date May 20, 1987 Page 2 of       

Project Golden Hills 4th Addition

Item Drainage Plan - 2 year storm.

Determine  $t_c$

<u>Node</u>	<u>overland flow</u>	<u>gutter flow</u>	<u>total</u>
416	-		
415	(Assumed)		5
414	125' @ 0.7 = 3 min	(750' @ 1.4) + (300 @ 2.6)	14
413	(Assumed)		5
412	(Assumed)		10
411	(Assumed)		10
410	Manhole		-
409	(Assumed)		10
408	(Assumed)		10
407	190' @ 0.7 fps = 4.5 min	1200' @ 1.7 fps = 11.8 min	16
406	125' @ 0.7 fps = 3 min	1330' @ 1.26 fps = 17 min	20



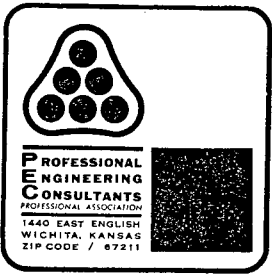
Date May 20, 1987 Page 3 of       

Project Golden Hills 4th Addition

Item Drainage Plan - 2 year storm

Determine  $I_2$

<u>Node</u>	<u><math>t_c</math></u>	<u><math>I_2</math></u>
416	start	
415	5	6.23
414	14	4.17
413	5	6.23
412	10	4.75
411	10	4.75
410	(Manhole)	
409	10	4.75
408	10	4.75
407	16	3.96
406	20	3.63



Date May 20, 1987 Page 4 of       

Project Golden Hills 4th

Item Drainage Plan

Determine  $Q_2$

<u>Node</u>	<u><math>C_2</math></u>	<u><math>I_2</math></u>	<u>A</u>	<u><math>Q_2</math></u>
416	-start			
415	0.69	6.23	1.7	7.3
414	0.55	4.17	2.5	5.8
413	0.69	6.23	2.7	11.6
412	0.55	4.75	2.2	5.7
411	0.40	4.75	1.9	3.6
410	(Manhole)			
409	0.69	4.75	3.3	10.8
408	0.58	4.75	0.4	1.1
407	0.55	3.96	6.0	13.1
406	0.55	3.63	6.1	12.2



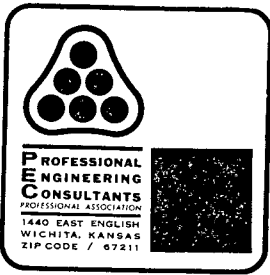
Date May 21, 1987 Page 5 of \_\_\_\_\_

Project bolden Hills 4th

Item Drainage Plan

INLET SIZING

<u>Node</u>	<u>Inlet Cond.</u>	<u>Q.</u>	<u>Design Freq</u>	<u>Qallow.</u>	<u>Inlet L</u>
416	Start	-	-	-	
415	Sump	9.4	5	11.0	5'
414	"	7.4	5	11.0	5'
413	"	14.9	5	22.0	10'
412	"	4.0	5	11.0	5'
411	"	6.0	5	11.0	5'
410	(Manhole)		-		
409	Sump	10.8	2	11.0	5'
408	"	1.1	2	11.0	5'
407	"	13.1	2	22.0	10'
406	"	12.2	2	22.0	10'



Date 5.21.87 Page 6 of         

Project Golden Hills 4th

Item Drainage Plan

STREET FLOW - MINOR STORM

<u>Node</u>	<u>Q</u>	<u>Distribution</u>	<u>street slope</u>	<u>d</u>	<u>Comment</u>
416	-				
415	9.4 (5yr)	100% (E) = 9.4	0.72%	0.43	OK
414	7.4 (5yr)	100% (N) = 7.4	0.40%	0.42	
413	14.9 (5yr)	50% (E) = 7.4 50% (N) = 7.5	0.72% 0.32%	0.38 0.45	
412	4.0 (5yr)	70% (N) = 2.8 30% (S) = 1.2	0.32% 0.32%	0.31 0.22	
411	6.0 (5yr)	70% (N) = 4.2 30% (S) = 1.8	0.32% 0.32%	0.36 0.26'	
410	(Manhole)				
409	10.8 (2yr)	90% (E) = 9.8 10% (W) = 1.0	0.40% 0.40%	0.46' 0.20	
408	1.1 (2yr)	50% (W) = 0.5 50% (N) = 0.6	0.40% 0.32%	0.16' 0.18'	
407	13.1 (2yr)	100% (E) = 13.1	0.40%	0.53'	
406	12.2 (2yr)	100% (E) = 12.2	0.32%	0.52'	



Date: 05-20-1987  
Time: 13:30:26

Input File: gh2yrq.stm

GOLDEN HILLS 4TH ADDITION DRAINAGE PLAN

P.E.C. PROJECT NO. 36-86576-1320

FILENAME gh2yrq.stm

PIPE SIZES FOR 2-YEAR Q RCP MANNING'S n=0.013

Storm Frequency = 2-Year

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

*****										*****				*****				
Tributary Area										Hydrology Summation				Conduit Data				
*****										*****				*****				
Node to	C	Area	Slope	Length	TC(0)	I(0)	Q(0)	TC	I	Q	Sum Q	Size	Velocity	Length	TT	TT+TC		
Node		(Ac)	(%)	(Ft)	(Min)	(In/Hr)	(CFS)	(Min)	(In/Hr)	(CFS)	(CFS)		(Ft/Sec)	(Ft)	(Min)	(Min)		
*****										*****				*****				
406	407	0.55	6.10	0.00	0.0	20.00	3.63	12.20	20.00	3.63	12.20	12.20	24"	3.88	225.00	0.97	20.97	
407	409	0.55	6.00	0.00	0.0	16.00	3.96	13.10	20.97	3.56	11.79	23.99	30"	4.89	75.00	0.26	21.22	
408	409	0.58	0.40	0.00	0.0	10.00	4.75	1.10	10.00	4.75	1.10	1.10	15"	0.90	30.00	0.56	10.56	
409	410	0.69	3.30	0.00	0.0	10.00	4.75	10.80	21.22	3.55	8.05	32.88	36"	4.65	135.00	0.48	21.71	
411	412	0.40	1.90	0.00	0.0	10.00	4.75	4.70	10.00	4.75	4.70	4.70	18"	2.66	50.00	0.31	10.31	
412	410	0.55	2.20	0.00	0.0	10.00	4.75	3.10	10.31	4.70	3.06	7.76	24"	2.47	125.00	0.84	11.16	
410	413	0.00	0.00	0.00	0.0	0.00	0.00	0.00	21.71	3.51	0.00	38.87	48"	3.09	440.00	2.37	24.08	
414	415	0.55	2.50	0.00	0.0	14.00	4.17	5.80	14.00	4.17	5.80	5.80	21"	2.41	350.00	2.42	16.42	
415	413	0.69	1.70	0.00	0.0	5.00	6.23	7.30	16.42	3.92	4.59	10.39	24"	3.31	300.00	1.51	17.93	
413	416	0.69	2.70	0.00	0.0	5.00	6.23	11.60	24.08	3.37	6.28	54.42	48"	4.33	90.00	0.35	24.42	
*****										*****				*****				

Date: 05-20-1987  
Time: 13:30:26

Input File: gh2yrq.stm

GOLDEN HILLS 4TH ADDITION DRAINAGE PLAN

P.E.C. PROJECT NO. 36-86576-1320

FILENAME gh2yrq.stm

PIPE SIZES FOR 2-YEAR Q RCP MANNING'S n=0.013

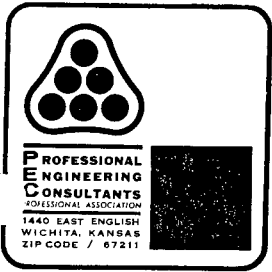
Storm Frequency = 2-Year

\* \* \* HYDRAULICS \* \* \*

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*****
Node   Hyd-Slope  Friction  Bend   Transition  Manhole  Deflection  Junction  Total  Hyd-GI  Desired  Diff.
      (Ft/Ft)   (Ft)     (Ft)   (Ft)        (Ft)     (Ft)       (Ft)     (Ft)   Elevation Elevation (Ft)
*****
```

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-GI Elevation	Desired Elevation	Diff. (Ft)
406	0.00291	0.6544	0.0000	0.0000	0.0000	0.0000	0.0000	0.6544	157.8530	159.0000	1.15
407	0.00342	0.2565	0.0000	0.0137	0.0000	0.0510	0.5558	0.8770	157.1986	158.2000	1.00
408	0.00029	0.0087	0.0000	0.0000	0.0000	0.0000	0.0000	0.0087	156.3303	158.2000	1.87
409	0.00243	0.3281	0.0000	0.0070	0.0000	0.0807	0.2002	0.6159	156.3216	158.2000	1.88
411	0.00200	0.1001	0.0000	0.0000	0.0000	0.0000	0.0000	0.1001	156.1035	157.1000	1.00
412	0.00118	0.1472	0.0000	0.0030	0.0000	0.0549	0.0927	0.2978	156.0034	157.1000	1.10
410	0.00073	0.3222	0.0000	0.0375	0.0000	0.1680	-0.1566	0.3711	155.7057	157.5000	1.79
414	0.00134	0.4690	0.0000	0.0000	0.0000	0.0000	0.0000	0.4690	156.6818	157.6000	0.92
415	0.00211	0.6330	0.0000	0.0080	0.0000	0.0000	0.2373	0.8782	156.2128	157.0000	0.79
413	0.00144	0.1292	0.0000	0.0143	0.0000	0.0000	0.2912	0.4346	155.3346	156.4000	1.07
416	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	154.9000	156.4000	1.50

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*****
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Date 4/15/87 MVB Page \_\_\_\_\_ of \_\_\_\_\_

Project GOLDEN HILLS 4TH ADD. DRAIN.

Item ASSUMED H.G.L. - CENTRAL STORM SEWER

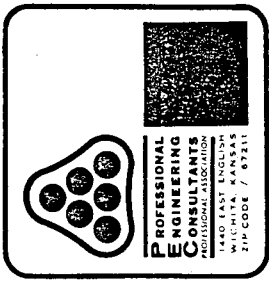
ANALYSIS OF STORM WATER SEWER IN CENTRAL IS BEYOND SCOPE OF THIS STUDY. THE STORM SEWER AT THE NW CORNER OF 119TH & CENTRAL IS TO BE ROUTED WEST ALONG CENTRAL TO PROPOSED LAKE IN BAY COUNTRY (NE 1/4 SEC 24-27-2W) APPROX. 1320' WEST OF 119TH ST W. PROPOSED LAKE STATIC POOL IS 1339.0 MSL (151.6 COW DATUM)

TO ESTABLISH H.G.L. @ NW CORNER OF 119TH & CENTRAL (NODE 413), ASSUME THE FOLLOWING:

- ① H.G.L. ELEV. AT LAKE = 1340 MSL (152.6 COW)
- ② 6 STRUCTURES AT 0.10' HEAD LOSS EACH
- ③ H.G.L. ELEV AT 119TH & CENTRAL = TOP OF CURB - 1' = 154.9

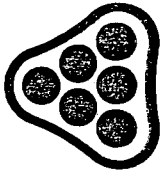
$$\text{H.G.L. SLOPE} = \frac{(154.9 - 152.6) - (6 \times 0.1')}{1320} = 0.0013 \text{ ft/ft}$$

USE T.C. - 1' = 154.9 @ NODE 413



Date 4/15/87 Page      of      Comp by MWB  
 Project Gibbs Hill 4TH DRAINAGE PLAN  
 Item      CK by       
 Recurrence Interval, Years 2 5 10 25 50 100  
 HYDROLOGY

AREA	OVERLAND FLOW					GUTTER FLOW							HYDROLOGY				
	L ft	S <sub>o</sub> ft/ft	V ft/sec	to min	T <sub>1</sub> /T <sub>2</sub>	T <sub>a</sub> /T <sub>2</sub>	L ft	S <sub>x</sub>	S <sub>o</sub>	V ft/s	tg min	tc-to-tg min	T ft	C	i in/hr	A Ac	Q cfs
406 C	125	0.01	0.7	3	0	0.65	1320	3/8	0.32	1.26	17.5	29.5	11	0.55	4.06	6.1	15.6
407 C	190	0.01	0.7	4.5	0	0.65	1200	"	0.40	1.7	11.8	16.3	14	0.55	5.09	6.0	16.8
408 D	60	0.01	0.7	1.5	0	0.65	125	"	0.55	1.6	1.3	USE 10	5	0.58	6.11	0.4	1.4
409	0	-	-	-	0	0.65	650	"	0.40	1.7	6.3	USE 10	14	0.69	6.11	3.3	13.9
410	MH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
411	200	0.01	0.7	5	0	0.65	325	"	0.32	1.26	4.3	USE 10	14	0.45	6.11	2.2	6.0
412	60	0.01	0.7	1.5	0	0.65	325	"	0.32	1.26	4.3	USE 10	14	0.55	6.11	1.2	4.0
414	125	0.01	0.7	3	0	0.65	825	"	0.52	1.3	10.5	14	14	0.55	5.36	2.5	7.4
415	160	0.01	2.0	1.3	0	0.45	300	"	0.7	2.6	1.9	USE 5	14	0.69	8.00	1.7	9.4
413	160	0.01	2.0	1.3	0.33	0.70	300	"	0.7	2.7	1.9	USE 5	14	0.69	8.00	2.7	14.9



**PROFESSIONAL  
ENGINEERING  
CONSULTANTS**  
PROFESSIONAL ASSOCIATION

1440 EAST ENGLISH  
WICHITA, KANSAS 67211  
(316) 262-2691

# HYDROLOGY DATA SHEET

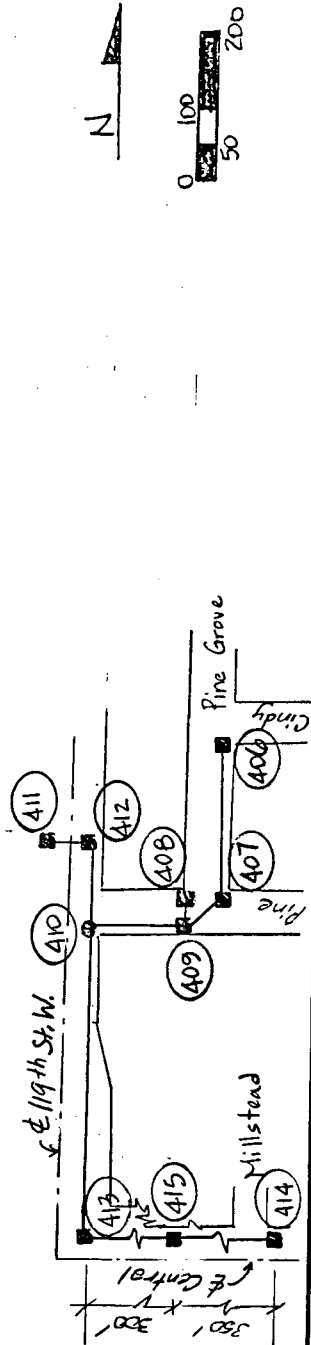
PAGE 50 OF 50

PROJECT: GOLDEN HILLS 4TH ADD'N DRAINAGE PLAN PROJECT NO. 36-86576-1320

ITEM: \_\_\_\_\_ DATE: 4/15/87

RETURN PERIOD: 5-YR COMPUTATIONS BY: MWB REVISIONS BY: \_\_\_\_\_

SCHEMATIC DIAGRAM:



SUB-BASIN (1)	TRIBUTARY AREA					HYDROLOGY SUMMATION					CONDUIT DATA						
	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T <sub>c</sub> (minutes) (6)	I <sub>0</sub> in./hr. (7)	Q <sub>0</sub> (cfs) (8)	T <sub>c</sub> (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	Σ Q (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft./sec.) (15)	LENGTH (feet) (16)	T <sub>t</sub> (minutes) (17)	T <sub>c</sub> + T <sub>t</sub> (minutes) (18)
406	0.55	6.1			20	4.66	15.6	20	4.66	15.6	15.6	30"	0.14	3.2	225	1.2	21.2
407	0.55	6.0			16	5.09	16.8	21.2	4.55	15.0	30.6	36"	0.21	4.3	75	0.3	21.5
408	0.58	0.4			10	6.11	1.4	10	6.11	1.4	1.4	15"	0.05	1.1	30	0.4	10.4
409	0.69	3.3			10	6.11	13.9	21.5	4.53	41.9	41.9	42"	0.18	4.4	135	0.5	22.0
411	0.40	1.9			10	6.11	6.0	10	6.11	6.0	6.0	21"	0.14	2.5	50	0.3	10.3
412	0.55	2.2			10	6.11	4.0	10.3	6.08	4.0	10.0	24"	0.20	3.2	125	0.7	11.0
410 MH	(4.49) (5.88)	10 + 49.5						22.0	4.49	49.5	49.5	48"	0.12	3.9	440	1.9	23.9





Date: 05-20-1987  
 Time: 12:42:07

Input File: gldhls.stm

GOLDEN HILLS 4TH ADDITION DRAINAGE PLAN  
 P.E.C. PROJECT NO. 36-86576-1320 FILENAME GLDHLS.STM  
 PIPE SIZES FOR 5-YEAR Q RCP MANNING'S n=0.013

Storm Frequency = 5-Year

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

*****													*****											
Tributary Area													Hydrology				Summation				Conduit Data			
*****													*****				*****							
Node to	C	Area	Slope	Length	TC(0)	I(0)	Q(0)	TC	I	Q	Sum Q	Size	Velocity	Length	TT	TT+TC								
Node		(Ac)	(%)	(Ft)	(Min)	(In/Hr)	(CFS)	(Min)	(In/Hr)	(CFS)	(CFS)		(Ft/Sec)	(Ft)	(Min)	(Min)								
*****													*****				*****							
406	407	0.55	6.10	0.00	0.0	20.00	4.66	15.60	20.00	4.66	15.60	15.60	24"	4.97	225.00	0.76	20.76							
407	409	0.55	6.00	0.00	0.0	16.00	5.09	16.80	20.76	4.60	15.18	30.78	36"	4.35	75.00	0.29	21.04							
408	409	0.58	0.40	0.00	0.0	10.00	6.11	1.40	10.00	6.11	1.40	1.40	15"	1.14	30.00	0.44	10.44							
409	410	0.69	3.30	0.00	0.0	10.00	6.11	13.90	21.04	4.57	10.40	42.24	42"	4.39	135.00	0.51	21.55							
411	412	0.40	1.90	0.00	0.0	10.00	6.11	6.00	10.00	6.11	6.00	6.00	21"	2.49	50.00	0.33	10.33							
412	410	0.55	2.20	0.00	0.0	10.00	6.11	4.00	10.33	6.03	3.95	9.95	24"	3.17	125.00	0.66	10.99							
410	413	0.00	0.00	0.00	0.0	0.00	0.00	0.00	21.55	4.53	0.00	49.89	54"	3.14	440.00	2.34	23.89							
414	415	0.55	2.50	0.00	0.0	14.00	5.36	7.40	14.00	5.36	7.40	7.40	24"	2.36	350.00	2.48	16.48							
415	413	0.69	1.70	0.00	0.0	5.00	8.01	9.40	16.48	5.03	5.90	13.30	30"	2.71	300.00	1.84	18.32							
413	416	0.69	2.70	0.00	0.0	5.00	8.01	14.90	23.89	4.35	8.10	69.99	54"	4.40	90.00	0.34	24.23							
*****													*****				*****							

Date: 05-20-1987  
Time: 12:42:07

Input File: gldhls.stm

GOLDEN HILLS 4TH ADDITION DRAINAGE PLAN  
P.E.C. PROJECT NO. 36-86576-1320 FILENAME GLDHLS.STM  
PIPE SIZES FOR 5-YEAR Q RCP MANNING'S n=0.013

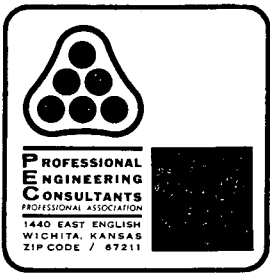
Storm Frequency = 5-Year

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

```
*****
Node   Hyd-Slope  Friction  Bend   Transition  Manhole  Deflection  Junction  Total  Hyd-Gl  Desired  Diff.
      (Ft/Ft)   (Ft)     (Ft)   (Ft)        (Ft)    (Ft)       (Ft)     (Ft)   Elevation  Elevation (Ft)
*****
```

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)
406	0.00476	1.0699	0.0000	0.0000	0.0000	0.0000	0.0000	1.0699	157.8474	159.0000	1.15
407	0.00213	0.1597	0.0000	0.0177	0.0000	0.0833	0.3619	0.6226	156.7775	158.2000	1.42
408	0.00047	0.0141	0.0000	0.0000	0.0000	0.0000	0.0000	0.0141	156.1689	158.2000	2.03
409	0.00176	0.2380	0.0000	0.0005	0.0000	0.0641	0.2016	0.5042	156.1548	158.2000	2.05
411	0.00143	0.0717	0.0000	0.0000	0.0000	0.0000	0.0000	0.0717	156.2124	157.1000	0.89
412	0.00193	0.2418	0.0000	0.0059	0.0000	0.0483	0.1940	0.4900	156.1407	157.1000	0.96
410	0.00064	0.2833	0.0000	0.0293	0.0000	0.1497	-0.1414	0.3209	155.6507	157.5000	1.85
414	0.00107	0.3745	0.0000	0.0000	0.0000	0.0000	0.0000	0.3745	156.1720	157.6000	1.43
415	0.00105	0.3156	0.0000	0.0028	0.0000	0.0000	0.1493	0.4677	155.7975	157.0000	1.20
413	0.00127	0.1140	0.0000	0.0148	0.0000	0.0000	0.3010	0.4298	155.3298	156.4000	1.07
416	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	154.9000	156.4000	1.50

```
*****
```



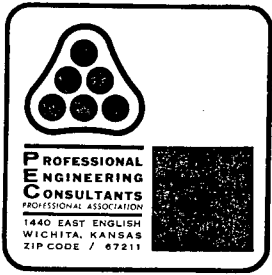
Date May 21, 1987 Page 1 of 3

Project Golden Hills 4th

Item Drainage Plan

100 - YR STORM

<u>Node</u>	<u>C<sub>100</sub></u>	<u>I<sub>100</sub></u>	<u>A</u>	<u>Q<sub>100</sub></u>
416	—			
415	0.80	10.32	1.7	14.0
414	0.73	7.57	2.5	13.8
413	0.80	10.32	2.7	22.3
412	0.79	8.54	2.2	14.8
411	0.60	8.54	1.9	9.7
410	(Manhole)			—
409	0.80	8.54	3.3	22.5
408	0.79	8.54	0.4	2.7
407	0.73	7.18	6.0	31.4
406	0.73	6.53	6.1	29.1



Date May 21, 1987 Page 2 of 3

Project Golden Hills 4th

Item Drainage Plan - 100-yr.

Check street flow Cindy St Approaching Nodes 406

$$Q_{100} = 29.1 \quad (\text{Node 406})$$

Assume Approx Same Q on N side

$$Q_{total} = 58.2$$

$$Q_{allow} = 67.3$$

(w/ slope = 0.32%)  
(see page 3)

street flow OK  
(walk grade = 0.4')

Check street flow Pine St. Approaching Nodes  
407, 408, 409

$$Q_{100} = 31.4 \quad (\text{Node 407})$$

$$2.7 \quad (\text{Node 408})$$

$$\underline{22.5} \quad (\text{Node 409})$$

$$\Sigma = 56.6$$

$$Q_{allowable} = 75.3$$

(w/ street slope = 0.4%)  
(see page 3)

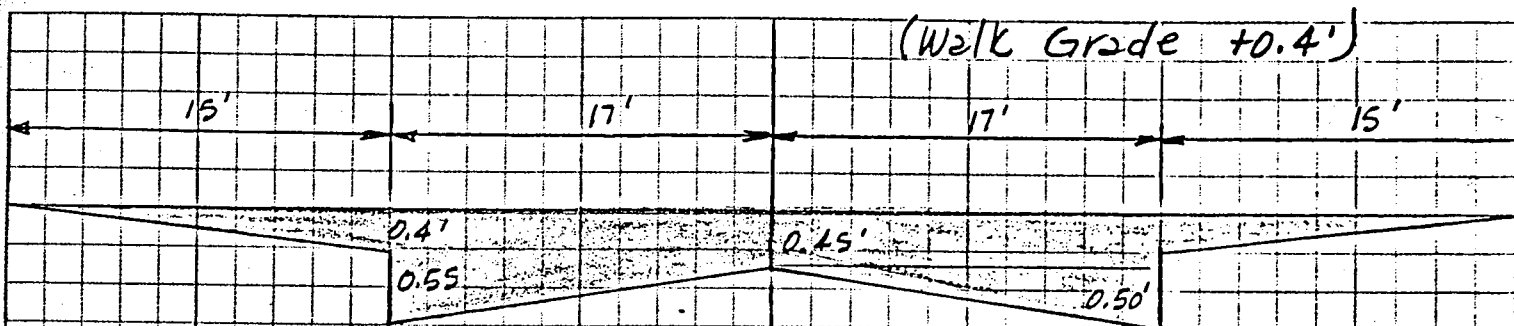
street flow OK  
(walk grade = 0.4)



Date May 21, 1987 Page 3 of 3

Project Golden Hills 4th Addition

Item Drainage Plan



$n: 0.0221$  (see previous sheet)

$$A = 2\left(\frac{1}{2} \times 15' \times 0.4'\right) + (34 \times 0.45') + 2\left(\frac{1}{2} \times 17' \times 0.5'\right)$$

$$= 29.8 \text{ SF}$$

$$P = 65.1'$$

$$R = A/P = 29.8/65.1 = 0.4577$$

$$R^{2/3} = 0.594$$

$$Q = \frac{1.486}{0.0221} \times 29.8 \times 0.594 \times 5^{1/2}$$

$$Q = 1,190.2 \text{ s}^{1/2}$$

## 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.

<u>DURATION</u> <u>IN MINUTES</u>	<u>RETURN PERIODS OF</u>						
	<u>1-YR</u>	<u>2-YR</u>	<u>5-YR</u>	<u>10-YR</u>	<u>25-YR</u>	<u>50-YR</u>	<u>100-YR</u>
5	4.67	6.23	8.00	9.34	10.67	12.23	13.79
6	4.35	5.80	7.45	8.70	9.94	11.39	12.84
7	4.09	5.46	7.02	8.19	9.36	10.72	12.09
8	3.88	5.18	6.66	7.77	8.89	10.18	11.48
9	3.71	4.95	6.36	7.43	8.49	9.72	10.96
10	3.56	4.75	6.11	7.13	8.15	9.33	10.52
11	3.43	4.58	5.89	6.87	7.85	8.99	10.14
12	3.32	4.43	5.69	6.64	7.59	8.69	9.80
13	3.21	4.29	5.51	6.43	7.35	8.42	9.50
14	3.12	4.17	5.36	6.25	7.14	8.18	9.23
15	3.04	4.06	5.21	6.08	6.95	7.97	8.98
16	2.96	3.96	5.09	5.93	6.78	7.77	8.76
17	2.90	3.86	4.97	5.79	6.62	7.59	8.55
18	2.83	3.78	4.86	5.67	6.48	7.42	8.37
19	2.77	3.70	4.76	5.55	6.34	7.27	8.19
20	2.72	3.63	4.66	5.44	6.22	7.12	8.03
21	2.67	3.56	4.57	5.34	6.10	6.99	7.88
22	2.62	3.49	4.49	5.24	5.99	6.86	7.74
23	2.57	3.43	4.41	5.15	5.89	6.74	7.60
24	2.53	3.38	4.34	5.07	5.79	6.63	7.48
25	2.49	3.32	4.27	4.99	5.70	6.53	7.36
26	2.45	3.23	4.21	4.91	5.61	6.43	7.25
27	2.42	3.13	4.15	4.84	5.53	6.33	7.14
28	2.38	3.05	4.09	4.77	5.45	6.25	7.04
29	2.35	2.97	4.02	4.68	5.38	6.16	6.95
30	2.32	2.89	3.92	4.56	5.31	6.08	6.79
31	2.29	2.82	3.82	4.44	5.19	6.00	6.62
32	2.26	2.75	3.73	4.33	5.07	5.87	6.45
33	2.24	2.68	3.64	4.23	4.95	5.73	6.30
34	2.19	2.62	3.55	4.13	4.83	5.60	6.16
35	2.14	2.57	3.47	4.04	4.73	5.47	6.02
36	2.09	2.51	3.40	3.95	4.62	5.35	5.89
37	2.05	2.46	3.33	3.87	4.52	5.23	5.76
38	2.00	2.41	3.26	3.79	4.43	5.13	5.64
39	1.96	2.36	3.19	3.71	4.34	5.02	5.53
40	1.92	2.32	3.13	3.64	4.26	4.92	5.42
41	1.89	2.27	3.07	3.57	4.18	4.83	5.32
42	1.85	2.23	3.01	3.51	4.10	4.74	5.22
43	1.82	2.19	2.96	3.44	4.02	4.65	5.13
44	1.78	2.15	2.91	3.38	3.95	4.56	5.03
45	1.75	2.11	2.86	3.32	3.88	4.48	4.95

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

ATTACHMENT A CONTINUED  
Page 2

<u>DURATION IN MINUTES</u>	<u>RETURN PERIODS OF</u>						
	<u>1-YR</u>	<u>2-YR</u>	<u>5-YR</u>	<u>10-YR</u>	<u>25-YR</u>	<u>50-YR</u>	<u>100-YR</u>
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

<u>DURATION IN MINUTES</u>	<u>RETURN PERIODS OF</u>						
	<u>1-YR</u>	<u>2-YR</u>	<u>5-YR</u>	<u>10-YR</u>	<u>25-YR</u>	<u>50-YR</u>	<u>100-YR</u>
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

<u>DURATION IN HOURS</u>	<u>RETURN PERIODS OF</u>						
	<u>1-YR</u>	<u>2-YR</u>	<u>5-YR</u>	<u>10-YR</u>	<u>25-YR</u>	<u>50-YR</u>	<u>100-YR</u>
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

## 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			
		<u>2</u>	<u>5</u>	<u>10</u>	<u>100</u>
<b>1. Business:</b>					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
<b>2. Residential:</b>					
<u>Single Family (Soil Group D)</u>					
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
<u>Multi-Family (Soil Group D)</u>					
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
<u>Single Family (Soil Group C)</u>					
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
<u>Multi-Family (Soil Group C)</u>					
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
<u>Single-Family (Soil Group B)</u>					
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
<u>Multi-Family (Soil Group B)</u>					
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 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

Land Use or Surface Characteristics	Percent Impervious	Frequency			
		<u>2</u>	<u>5</u>	<u>10</u>	<u>100</u>
<u>Soil Group D</u>					
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.

ATTACHMENT E

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

AVERAGE OVERLAND FLOW VELOCITY FOR USE WITH URBANIZED AREAS

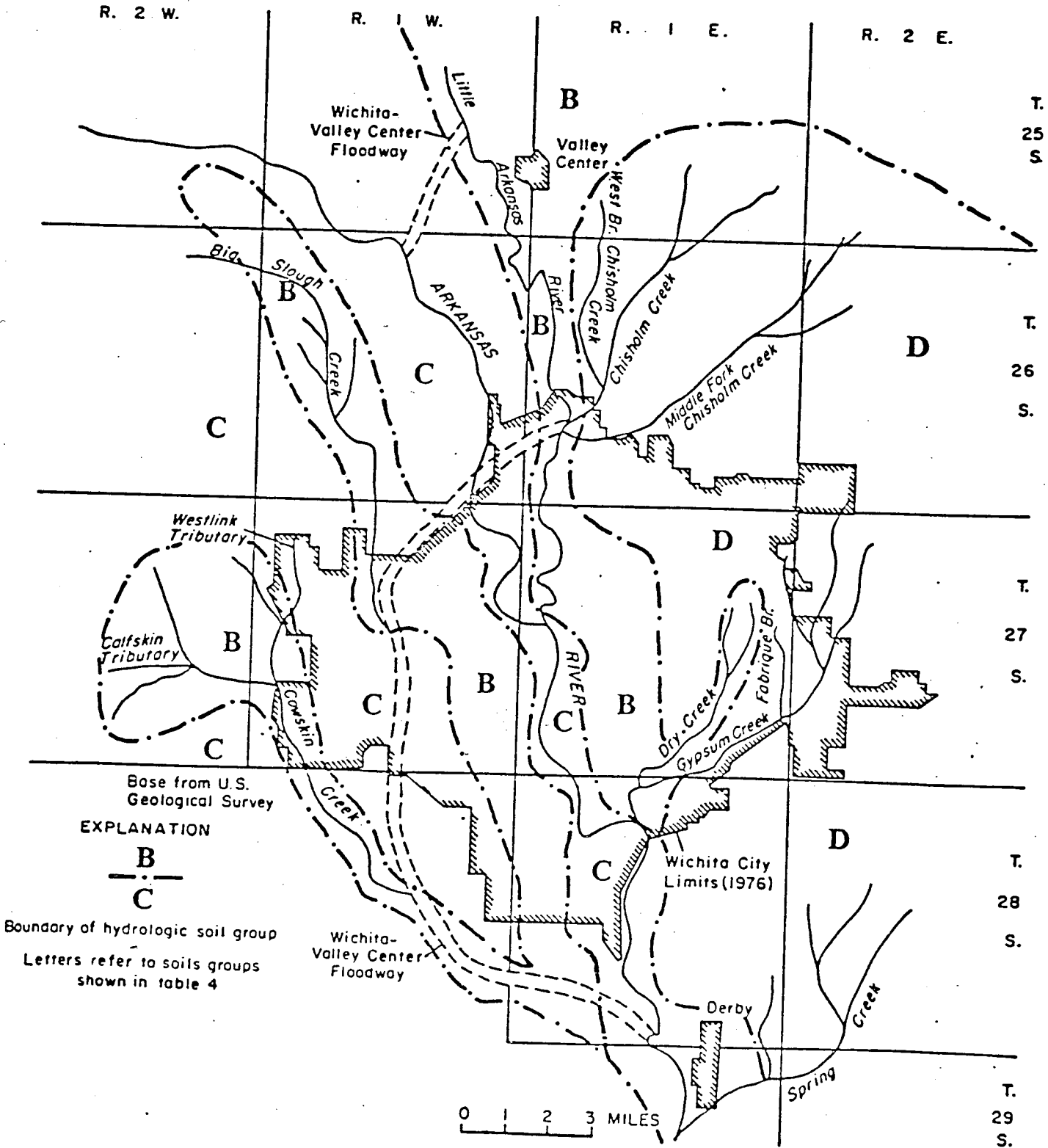
Surface Type	VELOCITY IN FEET/SECOND FOR SLOPES IN PERCENT SHOWN																				
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	20.0	
Forest with Heavy Ground Litter or Meadow	0.03	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.16	0.21	0.28	0.33	0.39	0.46	0.53	0.60	0.72	1.10	
Fallow or Minimum Tillage Cultivation	0.06	0.08	0.10	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.29	0.40	0.51	0.66	0.78	0.91	1.05	1.20	1.44	2.10	
Short Grass Pasture or Lawns	0.09	0.13	0.15	0.18	0.20	0.21	0.23	0.25	0.26	0.28	0.45	0.60	0.77	0.96	1.17	1.33	1.50	1.68	1.98	3.20	
Almost Bare Ground	0.16	0.22	0.28	0.31	0.35	0.38	0.41	0.44	0.46	0.49	0.70	0.85	1.05	1.26	1.50	1.75	2.03	2.32	2.79	4.40	
Gressed Waterway	0.35	0.48	0.58	0.67	0.77	0.84	0.91	0.98	1.05	1.12	1.54	1.82	2.10	2.38	2.78	3.20	3.66	4.14	4.56	7.00	
Paved Areas (Sheet Flow) or Shallow Gutter Flow	0.44	0.62	0.77	0.91	1.05	1.12	1.19	1.26	1.33	1.40	2.00	2.55	3.20	3.83	4.41	5.04	5.70	6.00	6.20	9.00	

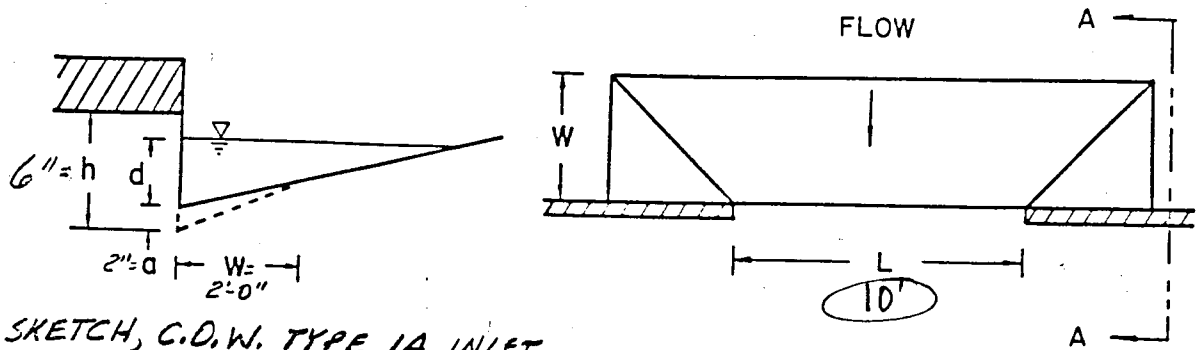
## EXHIBIT NO. 1

## SOIL LEGEND

<u>SYMBOL</u>	<u>HYDROLOGIC GROUP</u>	<u>NAME</u>
Aa	B	Albion-Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loams, 7 to 15 percent slopes
Ba	C	Blanket silt loam, 0 to 1 percent slopes
Bb	C	Blanket silt loam, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loam
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	Cline 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 slopes
Wa	C	Waldeck sandy loam
Wb	D	Waurika silt loam

EXHIBIT NO. 2





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

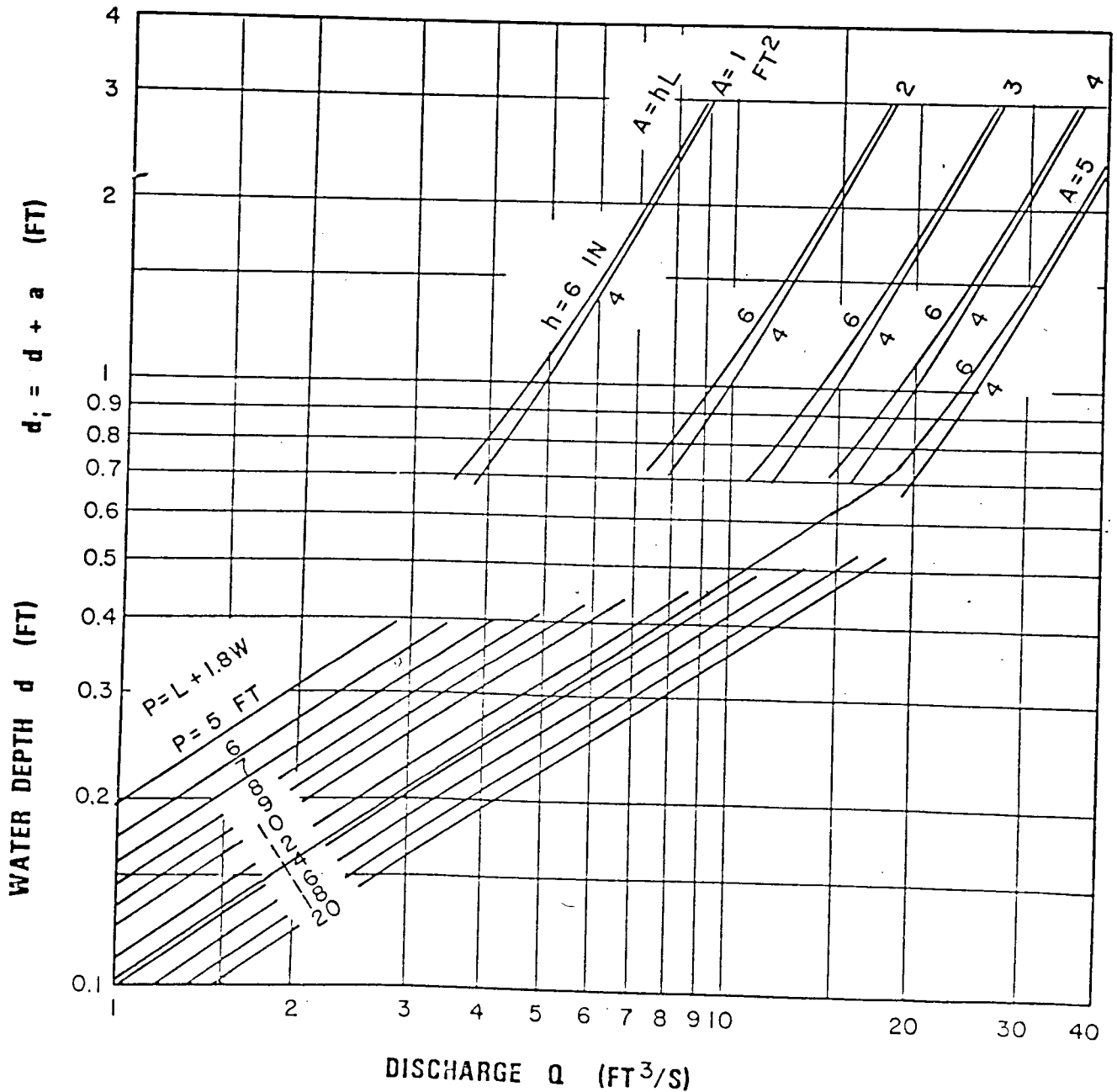
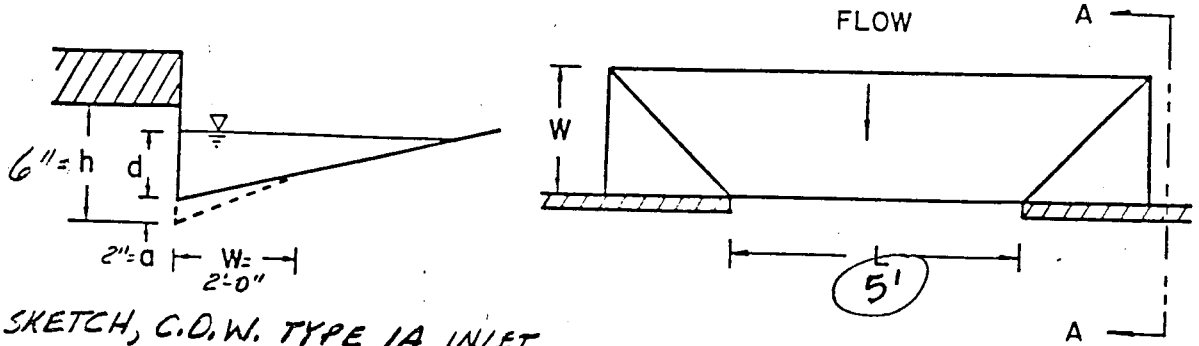


CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, FHWA, MAR, 1974



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

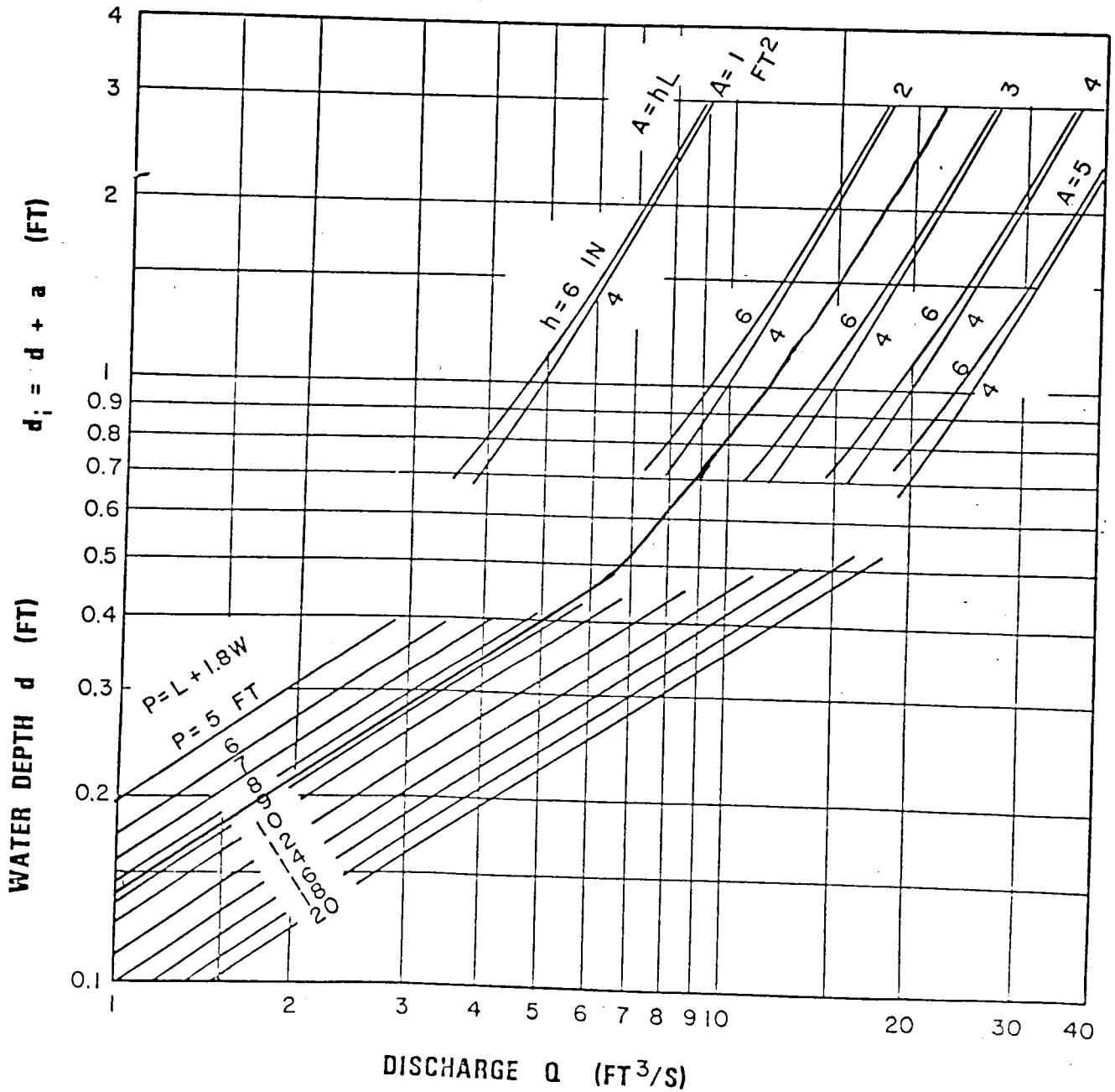
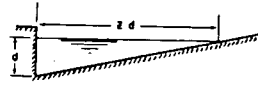


CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, FHWA, MAR, 1974

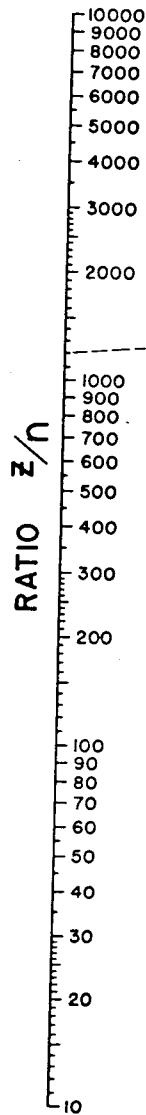
Chart 1



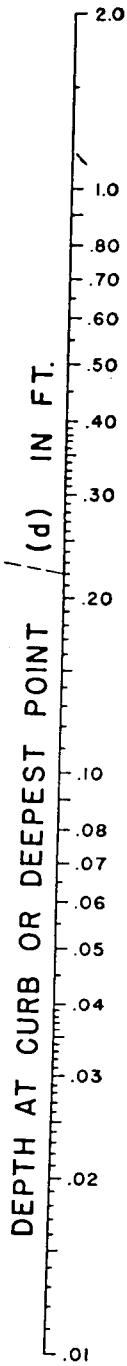
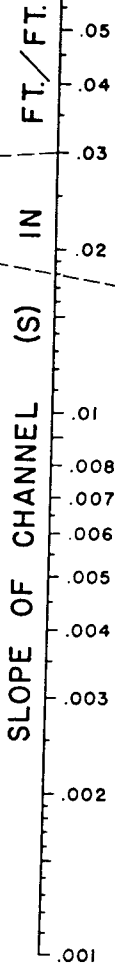
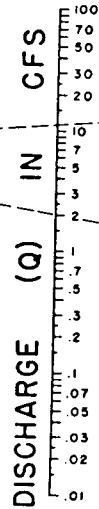
EQUATION:  $Q = 0.56 \left(\frac{z}{n}\right)^{3/2} d^{5/2}$   
 $n$  IS ROUGHNESS COEFFICIENT IN MANNING  
 FORMULA APPROPRIATE TO MATERIAL IN  
 BOTTOM OF CHANNEL  
 $z$  IS RECIPROCAL OF CROSS SLOPE  
 REFERENCE: H. R. B. PROCEEDINGS 1948,  
 PAGE 150, EQUATION (14)

EXAMPLE (SEE INSTRUCTION 1)

GIVEN:  $s = 0.03$   
 $z = 24$   
 $n = .02$  }  $z/n = 1200$   
 $Q = 20 \text{ CFS}$   
 FIND:  $d = 0.22$  BY FOLLOWING  
 DASHED LINES



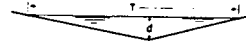
TURNING LINE



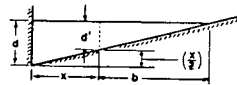
INSTRUCTIONS

1. 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.

2. FOR SHALLOW V-SHAPED CHANNEL AS SHOWN USE NOMOGRAPH AS EXPLAINED IN INSTRUCTION 1 BUT 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 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  $Q_x = Q - Q_b$ .



4. TO DETERMINE DISCHARGE ( $Q_1$ ) IN COMPOSITE SECTION: FOLLOW INSTRUCTION 3 TO OBTAIN DISCHARGE ( $Q_2$ ) IN SECTION  $a$  AT ASSUMED DEPTH  $d$  BASED ON AN EXTENSION OF SLOPE RATIO  $z_a$  TO INTERSECT WATER SURFACE; OBTAIN  $Q_b$  FOR SLOPE RATIO  $z_b$  AND DEPTH  $d'$ ;  $d' = d \frac{z_a}{z_b}$  THEN  $Q_1 = Q_2 + Q_b$ .

