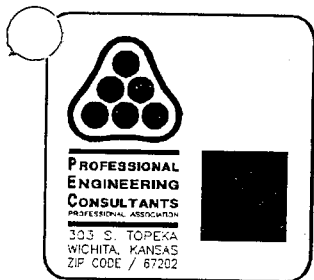


MEMO



TO: M.E. Lindebak, P.E.

455 N. Main, 7th Floor

Wichita, KS 67202

ATTN: V.R. Huang, P.E.

PROJECT NO. 36-97B37-3104

PROJECT: Evergreen Addition

DATE: 3-23-98

COPIES TO:

Socora Village

FROM: Darwin R. Cronk, P.E.

REFERENCE: Drainage Plan Computations

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

Attached hereto are the drainage 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 the following:

HYDROLOGIC ANALYSIS FOR STORM WATER SEWERS

For storm sewer design, the Rational Method was used for the hydrologic analysis in accordance with the Design Manual. Runoff coefficients were estimated based on tables presented in the Design Manual.

For this development, a uniform assumption of the minimum time of concentration of 15 minutes was deemed appropriate.

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 were checked for the minor storm. Conveyance in the street is based on the Modified Manning's Equation, as expressed in Manual #1, Equation (5-1), page 5-9. It has been assumed that T_c for street flow is equal for T_c for pipe flow. This is a simplifying, but conservative, assumption, since pipe flow velocities generally exceed street flow velocities.

For local streets, curb-deep flow is tolerable for the minor storm. For collector streets, a single eight-foot center lane should remain unflooded for the minor storm.

Inlet capacities were determined by the methods described in Manual #2, using Chart #12.

In this analysis, City of Wichita Type IA inlets and 3/8 inch per foot street cross slopes have been assumed. Minimum walk grade has been assumed to be 0.3 feet above the top of curb, unless otherwise noted. Streets have been assumed to have 6-5/8 inch standard curb, unless otherwise noted.

Storm sewers are designed for the minor storm, with major storm overflows to be routed through easements and rights-of-way to an appropriate outlet.

For residential areas, the minor storm has a recurrence interval of two years and in commercial areas has a recurrence interval of five years. The major storm evaluated has a recurrence interval of one hundred years.

To simplify hydraulic analysis, the following assumptions have been made:

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

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

M. E. Lindebak, P.E.

Evergreen Addition

3-23-98

Page 3

Runoff and storm sewer analysis for Lot 21, Block 9 and Lot 26, Block 7 have not been performed as part of this drainage plan. These lots are larger commercial and multi-family lots. The owner or developer of these lots will be required to perform individual drainage analyses for the lot based on the proposed development plan. Lot 26, Block 7 should be designed to discharge runoff to the pond in Reserve A., or the existing pond on the lot. Lot 21, Block 9, will be permitted to discharge to the existing pond on the lot.

HYDRAULIC MODELS FOR DETENTION

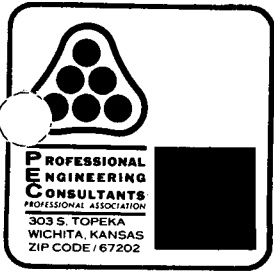
Detention storage computations were not performed as part of this drainage study. The drainage plan for New Market Square Addition includes the computations for the detention pond within Reserve A.

DESIGN AIDS

Charts, nomographs, etc. used in these computation are reprinted in this section

DRAINAGE PLAN MAP

A map at 1"=100' scale is include in the map pocket(s) at the back of the report.



Date 3/21/98 Page 1 of 5
 Project EVERGREEN ADDITION
 Item DRAINAGE PLAN SWS #1

I. HYDROLOGY

Using Rational Method, $Q = CiA$

DETERMINE "C"

<u>BASIN</u>	<u>NODE</u>	<u>Soil Type</u>	<u>Hydrologic Group</u>	<u>Land Use</u>	<u>C₂</u>	<u>C₁₀₀</u>
1A	110	Vb	B	1/4 ac. Res.	0.44	0.61
1B	120	Vb	B	1/4 ac. Res.	0.44	0.61
1C	130	Vb	B	1/4 ac. Res.	0.44	0.61

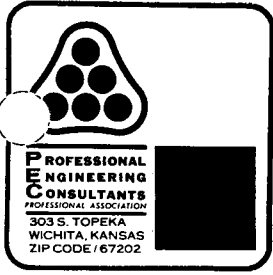
DETERMINE "I"

Assume $T_c = 15$ min. for all basins

$\therefore I_2 = 3.83$ in/hr $I_{100} = 7.37$ in/hr

DETERMINE "A"

<u>BASIN</u>	<u>NODE</u>	<u>AREA (ac.)</u>
1A	110	1.27
1B	120	3.57
1C	130	2.60



Date 3/21/98 Page 2 of 5
 Project EVERGREEN ADDITION
 Item DRAINAGE PLAN SWS#1

DETERMINE "Q₂"

<u>BASIN</u>	<u>NODE</u>	<u>C₂</u>	<u>I₂</u>	<u>A</u>	<u>Q₂</u>
IA	110	0.44	3.83	1.27	2.1
IB	120	0.44	3.83	3.57	6.0
IC	130	0.44	3.83	2.60	4.4

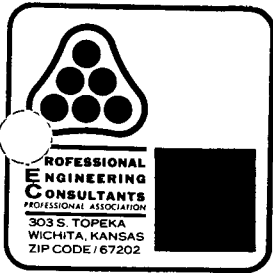
DETERMINE "Q₁₀₀"

<u>BASIN</u>	<u>NODE</u>	<u>C₁₀₀</u>	<u>I₁₀₀</u>	<u>A</u>	<u>Q₁₀₀</u>
IA	110	0.61	7.37	1.27	5.7
IB	120	0.61	7.37	3.57	16.0
IC	130	0.61	7.37	2.60	11.7

II. INLET SIZING / FLOOD ROUTING (2-YEAR)

<u>BASIN</u>	<u>NODE</u>	<u>Inlet Condition</u>	<u>Q₂</u>	<u>Q_{max} (5' Inlet)</u>	<u>Q_{max} (10' Inlet)</u>	<u>Q_{intercept} †</u>	<u>Q_{bypass}</u>	<u>USE L =</u>
IA	110	Sump	2.1	11.0	22.0	2.1	—	5'
IB	120	Sump	6.0	11.0	22.0	6.0	—	5'
IC	130	Sump	4.4	11.0	22.0	4.4	—	5'

† Q_{intercept} = use as input data in storm sewer sizing program



Date 3/22/98 Page 3 of 5

Project EVERGREEN ADDITION

Item DRAINAGE PLAN SWS #1

III. STREET FLOW

2-YEAR

<u>NODE</u>	<u>BASIN</u>	<u>Q₂</u>	<u>Distribution</u>	<u>Street Slope</u>	<u>d</u>	<u>d_{max}</u>	<u>Comment</u>
120	1B	6.0	70% (N) = 4.2	0.4%	0.35'	0.55'	OK
			30% (S) = 1.8	0.4%	0.26'	0.55'	OK

BY INSPECTION, ALL NODES ARE OK.

100-YEAR

$Q_{street} = Q_{100} - Q_{pipe}$

<u>Location</u>	<u>Contributing Area</u>	<u>Q₁₀₀</u>	<u>Q_{pipe}</u>	<u>Q_{street}</u>	<u>Street Slope</u>	<u>Q_{max} #</u>	<u>Comment</u>
Approaching Nodes 110 & 120 from N	50% 1A =	2.9	0				
	60% 1B =	9.6	0				
	100% 1C =	11.7	4.4				
		24.2	4.4	19.8	0.5%	54.6	OK

Std. Cb.
Wk. Gr. = 0.3

BY INSPECTION, ALL LOCATIONS ARE OK.

- See Design Aid

IV. OVERFLOW

100-YR FLOW AT NODES 110 & 120 WILL BE DESIGNED TO OVERTOP CURB AND SPILL INTO ADJACENT PROPOSED LAKE.

Date: 03-23-1998
Time: 10:00:21

Input File: C:\OUTPUT\EVGRN1.STM

EVERGREEN ADDITION
SWS #1
DAR 3-23-98

Storm Frequency = 2-Year

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

Tributary Area		Hydrology Summation				Conduit Data										
Node to	C	Area (Ac)	Slope (%)	Length (Ft)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
130	120	.00	.00	.00	15.00	3.83	4.40	4.40	15.00	3.83	4.40	15"	3.59	180.00	.84	15.84
120	110	.00	.00	.00	15.00	3.83	6.00	10.25	15.84	3.73	5.85	18"	5.80	35.00	.10	15.94
110	100	.00	.00	.00	15.00	3.83	2.10	12.30	15.94	3.72	2.04	24"	3.91	100.00	.43	16.36

Date: 03-23-1998
Time: 10:00:21

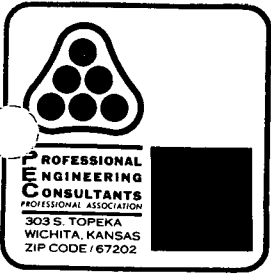
Input File: C:\OUTPUT\EVERGRN1.STM

EVERGREEN ADDITION
SWS #1
DAR 3-23-98

Storm Frequency = 2-Year

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

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.
100	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	161.5000	161.5000	.00
110	.00295	.2954	.0000	.0570	.0000	.0430	-.1128	.2825	161.7825	165.6000	3.82
120	.00953	.3334	.0000	.0323	.0000	.0998	.9438	1.4093	163.1919	165.6000	2.41
130	.00464	.8351	.0000	.0000	.0000	.0000	.0000	.8351	164.0270	166.4000	2.37



Date 3/21/98 Page 1 of

Project EVERGREEN ADDITION

Item DRAINAGE PLAN SWS #2

I. HYDROLOGY

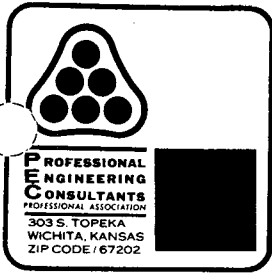
DETERMINE "C"

<u>BASIN</u>	<u>NODE</u>	<u>Soil Type</u>	<u>Hydrologic Group</u>	<u>Land Use</u>	<u>C₂</u>	<u>C₁₀₀</u>
2A	210	Vb	B	1/4 ac. Res.	0.44	0.61
2B	230	Vb	B	1/4 ac. Res.	0.44	0.61
2C	220	Vb, Ta	60% B, 40% D	1/4 ac. Res.	0.46	0.67
2D	280	Vb	B	1/4 ac. Res.	0.44	0.61
2E	290	Ta, Vb	90% D, 10% B	1/4 ac. Res.	0.49	0.75
2F	240	Ta, Vb	40% B, 60% D	1/4 ac. Res.	0.48	0.70
2G	250	Vb, Ta	70% B, 30% D	1/4 ac. Res.	0.46	0.66
2H	260	Vb, Ta	75% B, 25% D	1/4 ac. Res.	0.45	0.65
2I	270	Vb, Ta	80% B, 20% D	1/4 ac. Res.	0.45	0.64

DETERMINE "I"

Assume $T_c = 15$ min. for all basins

∴ $I_2 = 3.83$ "/hr $I_{100} = 7.37$ "/hr.



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Project EVERGREEN ADDITION

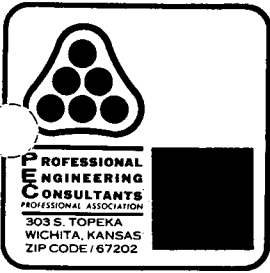
Item DRAINAGE PLAN SWS#2

DETERMINE "A"

<u>BASIN</u>	<u>NODE</u>	<u>AREA (ac.)</u>
2A	210	1.44
2B	230	1.89
2C	220	0.50
2D	280	0.98
2E	290	0.98
2F	240	6.62
2G	250	3.99
2H	260	2.00
2I	270	2.85

DETERMINE "Q₂"

<u>BASIN</u>	<u>NODE</u>	<u>C₂</u>	<u>I₂</u>	<u>A</u>	<u>Q₂</u>
2A	210	0.44	3.83	1.44	2.4
2B	230	0.44		1.89	3.2
2C	220	0.46		0.50	0.9
2D	280	0.44		0.98	1.6
2E	290	0.49		0.98	2.0 1.8
2F	240	0.48		6.62	12.2
2G	250	0.46		3.99	7.0
2H	260	0.45		2.00	3.4
2I	270	0.45		2.85	1.2



Date 3/21/98 Page 3 of

Project EVERGREEN ADDITION

Item DRAINAGE ADDITION SWS#2

DETERMINE "Q₁₀₀"

<u>BASIN</u>	<u>NODE</u>	<u>C₁₀₀</u>	<u>I₁₀₀</u>	<u>A</u>	<u>Q₁₀₀</u>	
2A	210	0.61	7.37	1.44	6.5	
2B	230	0.61		1.89	8.5	
2C	220	0.67		0.50	2.5	
2D	280	0.61		0.98	4.4	
2E	290	0.75		0.98	5.4	
2F	240	0.70		6.62	34.2	
2G	250	0.66		3.99	19.4	
2H	260	0.65		2.00	9.6	
2I	270	0.64		7.37	2.85	13.4

* - Q_{intercept} = Use as input data in storm sewer sizing program

II. ~~DETERMINE~~ INLET SIZING / FLOOD ROUTING (2-YEAR)

<u>BASIN</u>	<u>NODE</u>	<u>INLET Condition</u>	<u>Q₂</u>	<u>Q_{max} (5' Inlet)</u>	<u>Q_{max} (10' Inlet)</u>	<u>Q_{intercept} *</u>	<u>Q_{bypass}</u>	<u>Use L =</u>
2A	210	Sump	2.4	11.0	22.0	2.4		5'
2B	230	Sump	3.2			3.2		5'
2C	220	Sump	0.9			0.9		5'
2D	280	Sump	1.6			1.6		5'
2E	290	Sump	1.8			1.8		5'
2F	240	Sump	12.2			11.0	1.2 to (250)	5'
2G	250	Sump	7.0			$\frac{7.0+1.2}{8.2}$		5'
2H	260	Sump	3.4			3.4		5'



Date 3/22/98 Page 4 of

Project EVERGREEN ADDITION

Item DRAINAGE PLAN SWS #2

III. STREET FLOW

2-YEAR

<u>NODE</u>	<u>BASIN</u>	<u>Q₂</u>	<u>Distribution</u>	<u>Street Slope</u>	<u>d</u>	<u>d_{max}</u>	<u>Comment</u>
240	2F	12.2	95% (S) = 11.6	0.4%	0.50'	0.55'	OK

BY INSPECTION, ALL NODES ARE OK

100-YEAR

$Q_{STREET} = Q_{100} - Q_{pipe}$

<u>Location</u>	<u>Contributing Area</u>	<u>Q₁₀₀</u>	<u>Q_{pipe}</u>	<u>Q_{street}</u>	<u>Q_{max} #</u>	<u>Comment</u>
Approaching Nodes 240 & 250 from S	95% 2F =	32.5	0			OK Std. Cb. = 0.3'
	70% 2G =	13.6	0			
		46.1	0	46.1	54.9	

Approaching Nodes 210 & 230 from N	50% 2A =	3.2	0			OK Std. Cb. = 0.4' WK Gr.
	40% 2B =	3.4	0			
	100% 2C =	2.5	0.9			
	100% 2D =	4.4	1.6			
	100% 2E =	5.4	1.8			
	100% 2F =	34.2	11.0			
	100% 2G =	19.4	8.2			
	100% 2H =	9.6	3.4			
	100% 2I =	13.4	4.9			
		95.5	31.8	63.7	74.3	

- See Design Aid



Date 3/22/98 Page 5 of

Project

Item

IV. OVERFLOW CHANNEL

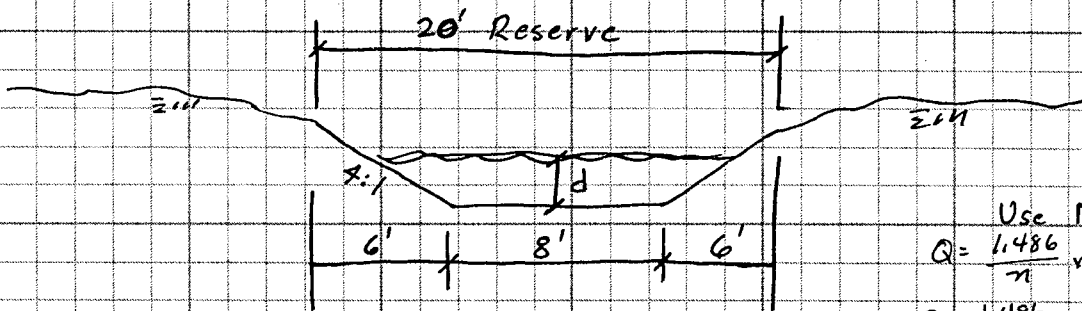
Q₂ IS DESIGNED TO FLOW THRU PIPES. Q₁₀₀ - Q₂ FLOW MUST BE CARRIED OVERLAND BETWEEN LOTS 10 & 11, BLOCK 7 TO THE PROPOSED LAKE

FROM NODE 210 TO 200:

$$Q_{\text{OVERLAND}} = Q_{100} - Q_{\text{PIPE}}$$

$$= 103.9 - 37.4 = 66.5 \text{ cfs}$$

Channel Section



Use Manning's Eq.

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

$$Q = \frac{1.486}{.03} \times A \times R^{2/3} \times (.02)^{1/2}$$

$$Q = 7.0 A R^{2/3}$$

<u>d</u>	<u>A</u>	<u>P</u>	<u>R</u>	<u>R^{2/3}</u>	<u>AR^{2/3}</u>	<u>Q</u>
0.8'	8.96	14.6	0.614	0.72	6.45	45.2
1.0' 1.0'	12.0	16.25	0.738	0.82	9.84	68.9 ← Q = 66.5 d = 1.0'
1.2'	15.36	17.9	0.858	0.90	13.82	96.7

Use d = 1.0' V = Q/A = $\frac{66.5}{12.0} = 5.54 \text{ fps}$ OK

Date: 03-23-1998
Time: 10:58:50

Input File: C:\OUTPUT\EVGRN2.STM

EVERGREEN ADDITION
SWS #2
DAR 3-23-98

Storm Frequency = 2-Year

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

Node	Tributary Area			Hydrology Summation				Conduit Data								
	C	Area (Ac)	Slope (%)	Length (Ft)	TC (Min)	I (In/Hr)	Q(0) (CFS)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)	
270	260	.00	.00	.0	15.00	3.83	4.90	15.00	3.83	4.90	4.90	15"	3.99	35.00	.15	15.15
260	255	.00	.00	.0	15.00	3.83	3.40	15.15	3.81	3.39	8.29	24"	2.64	355.00	2.24	17.39
255	240	.00	.00	.0	.00	.00	.00	17.39	3.57	.00	8.29	24"	2.64	220.00	1.39	18.78
250	240	.00	.00	.0	15.00	3.83	8.20	15.00	3.83	8.20	8.20	18"	4.64	40.00	.14	15.14
240	235	.00	.00	.0	15.00	3.83	11.00	18.78	3.44	9.89	25.57	30"	5.21	225.00	.72	19.50
290	280	.00	.00	.0	15.00	3.83	1.80	15.00	3.83	1.80	1.80	15"	1.47	40.00	.45	15.45
280	235	.00	.00	.0	15.00	3.83	1.60	15.45	3.78	1.58	3.38	15"	2.75	130.00	.79	16.24
235	230	.00	.00	.0	.00	.00	.00	19.50	3.38	.00	28.66	30"	5.84	355.00	1.01	20.51
230	210	.00	.00	.0	15.00	3.83	3.20	20.51	3.29	2.75	31.42	36"	4.44	40.00	.15	20.66
220	215	.00	.00	.0	15.00	3.83	.90	15.00	3.83	.90	.90	15"	.73	140.00	3.18	18.18
215	210	.00	.00	.0	.00	.00	.00	18.18	3.50	.00	.90	15"	.73	110.00	2.50	20.68
210	200	.00	.00	.0	15.00	3.83	2.40	20.66	3.28	2.06	34.37	36"	4.86	200.00	.69	21.35

Date: 03-23-1998
Time: 10:58:50

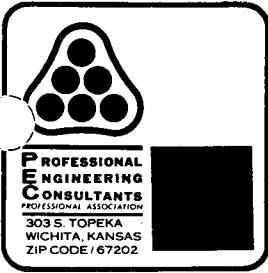
Input File: C:\OUTPUT\EVGRN2.STM

EVERGREEN ADDITION
SWS #2
DAR 3-23-98

Storm Frequency = 2-Year

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

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.
200	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	161.5000	161.5000	.00
210	.00266	.5311	.0000	.0060	.0000	.0110	.1327	.6808	162.1808	166.2000	4.02
220	.00019	.0272	.0000	.0000	.0000	.0000	.0000	.0272	162.2314	167.1000	4.87
230	.00222	.0887	.0000	.0446	.0000	.0190	-.1265	.0258	162.2066	166.2000	3.99
215	.00019	.0214	.0000	.0000	.0004	.0007	.0010	.0234	162.2042	166.6000	4.40
235	.00488	1.7338	.0000	.0108	.0000	.0000	.2384	1.9830	164.1896	168.5000	4.31
280	.00274	.3556	.0000	.0084	.0000	.0000	.1776	.5417	164.7313	166.9000	2.17
290	.00078	.0311	.0000	.0000	.0000	.0000	.0000	.0311	164.7623	166.9000	2.14
240	.00389	.8747	.0000	.0313	.0000	.0540	.5799	1.5399	165.7296	166.9000	1.17
250	.00609	.2438	.0000	.0000	.0000	.0000	.0000	.2438	165.9733	166.9000	.93
255	.00134	.2951	.0000	.0000	.0054	.0000	.0067	.3072	166.0368	168.2000	2.16
260	.00134	.4762	.0000	.0279	.0000	.1238	.0503	.6782	166.7149	168.3000	1.59
270	.00575	.2014	.0000	.0000	.0000	.0000	.0000	.2014	166.9163	168.3000	1.38



Date 3/22/98 Page 1 of
 Project EVERGREEN ADDITION
 Item DRAINAGE PLAN S&S #3

I. HYDROLOGY

DETERMINE "C"

<u>BASIN</u>	<u>NODE</u>	<u>Soil Type</u>	<u>Hydrologic Group</u>	<u>Land Use</u>	<u>C₂</u>	<u>C₁₀₀</u>
3A	310	T _a	D	1/4 ac. Res.	0.5	0.76
3B	320	T _a , V _b	60% D, 40% B	1/4 ac. Res.	0.48	0.70

DETERMINE "I"

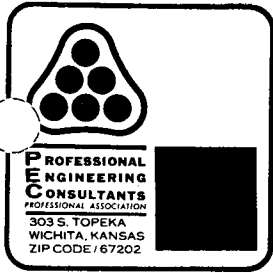
Assume $T_c = 15$ min. for all basins
 $\therefore I_2 = 3.83$ in/hr $I_{100} = 7.37$ in/hr

DETERMINE "A"

<u>BASIN</u>	<u>NODE</u>	<u>AREA (ac.)</u>
3A	310	1.15
3B	320	6.54

DETERMINE "Q₂"

<u>BASIN</u>	<u>NODE</u>	<u>C₂</u>	<u>I₂</u>	<u>A</u>	<u>Q₂</u>
3A	310	0.5	3.83	1.15	2.2
3B	320	0.48	3.83	6.54	12.02



Date 3/22/98 Page 2 of
 Project EVERGREEN ADDITION
 Item DRAINAGE PLAN SWS #3

DETERMINE "Q₁₀₀"

<u>BASIN</u>	<u>NODE</u>	<u>C₁₀₀</u>	<u>I₁₀₀</u>	<u>A</u>	<u>Q₁₀₀</u>
3A	310	0.76	7.37	1.15	6.4
3B	320	0.70	7.37	6.54	33.7

II. INLET SIZING / FLOOD ROUTING

<u>BASIN</u>	<u>NODE</u>	<u>Inlet Condition</u>	<u>Q₂</u>	<u>Q_{max} (5' Inlet)</u>	<u>Q_{max} (10' Inlet)</u>	<u>Q_{intercept} †</u>	<u>Q_{bypass}</u>	<u>Use L =</u>
320 3B	320	Sump	12.0	11.0	22.0	11.0	10 to <u>(310)</u>	5'
3A	310	Sump	2.2	11.0	22.0	2.2+11.0=3.2	—	5'

† - To be used in storm sewer sizing program

III. STREET FLOW

2-YEAR

<u>NODE</u>	<u>BASIN</u>	<u>Q₂</u>	<u>Distribution</u>	<u>Street Slope</u>	<u>d</u>	<u>d_{max}</u>	<u>Comment</u>
320	3B	12.0	60% (S) = 7.2	0.4%	0.42'	0.55'	OK

BY INSPECTION, ALL NODES ARE OK.

100-YEAR

* - See Design Aid

<u>Location</u>	<u>Q_{street} = Q₁₀₀ - Q_{pipe}</u>	<u>Contrib. Area</u>	<u>Q₁₀₀</u>	<u>Q_{pipe}</u>	<u>Q_{street}</u>	<u>Q_{max} *</u>	<u>Comment</u>
Approaching Nodes	60% 3A	=	3.8	0			
310 & 320 from S	60% 3B	=	20.2	0			
			24	0	24	54.9	OK. Std. Ch.



Date 3/22/98 Page 3 of

Project

Item SWS #3

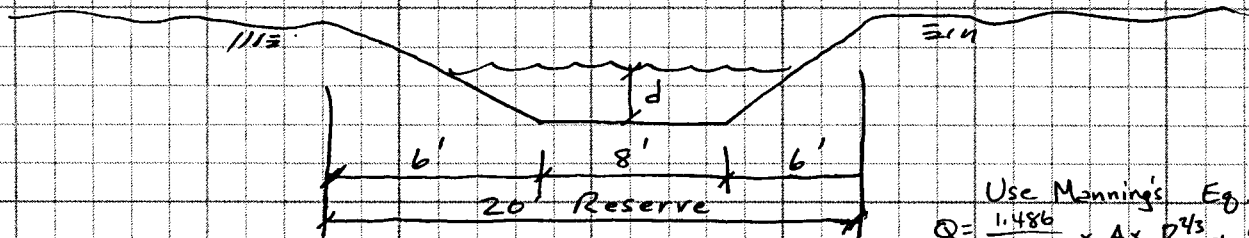
IV. OVERFLOW CHANNEL

Q₂ IS DESIGNED TO FLOW THRU PIPES. Q₁₀₀ - Q₂ FLOW MUST BE CARRIED OVERLAND BETWEEN LOTS 19 & 20, BLOCK 7, TO THE PROPOSED LAKE.

FROM NODE 310 TO 300:

$$\begin{aligned}
 Q_{\text{OVERLAND}} &= Q_{100} - Q_{\text{PIPE}} \\
 &= 40.1 - 14.2 \\
 &= \text{25.9 cfs}
 \end{aligned}$$

CHANNEL SECTION



Use Manning's Eq.

$$Q = \frac{1.486}{.03} \times A \times R^{2/3} \times S^{1/2}$$

$$Q = 49.5 \times A \times R^{2/3} \times (.02)^{1/2}$$

$$Q = 7.0 AR^{2/3}$$

<u>d</u>	<u>A</u>	<u>P</u>	<u>R</u>	<u>R^{2/3}</u>	<u>AR^{2/3}</u>	<u>Q</u>
0.4'	3.84	11.3	0.3398	0.487	1.87	13.0
0.5'	5.0	12.12	0.4125	0.554	2.77	19.4
0.6'	6.24	12.95	0.4819	0.615	3.84	26.8 ← Q = 25.9 cfs

Use $d = 0.6'$ $V = \frac{25.9}{6.24} = 4.2 \text{ fps}$ OK

Date: 03-23-1998
Time: 11:08:00

Input File: C:\OUTPUT\EVGRN3.STM

EVERGREEN ADDITION
SWS #3
DAR 3-23-98

Storm Frequency = 2-Year

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

Tributary Area		Hydrology Summation				Conduit Data								
Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC (Min)	I (In/Hr)	Q (CFS)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
320	310	.00	.00	.0	15.00	3.83	11.00	15.00	3.83	11.00	11.00	40.00	.11	15.11
310	300	.00	.00	.0	15.00	3.83	3.20	15.11	3.82	3.19	14.19	200.00	.74	15.85

Date: 03-23-1998
Time: 11:08:00

Input File: C:\OUTPUT\EVGRN3.STM

EVERGREEN ADDITION
SWS #3
DAR 3-23-98

Storm Frequency = 2-Year

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

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.
300	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	161.5000	161.5000	.00
310	.00393	.7869	.0000	.0570	.0000	.0000	-.0182	.8256	162.3256	166.2000	3.87
320	.01097	.4386	.0000	.0000	.0000	.0000	.0000	.4386	162.7643	166.2000	3.44



Date 3/22/98 Page 1 of

Project EVERGREEN ADDITION

Item DRAINAGE ADDITION SWS #4

I. HYDROLOGY

DETERMINE "C"

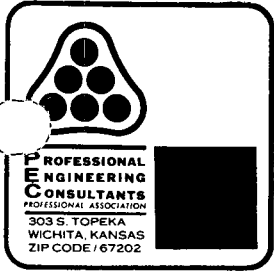
<u>BASIN</u>	<u>NODE</u>	<u>Soil Type</u>	<u>Hydrologic Group</u>	<u>Land Use</u>	<u>C₂</u>	<u>C₁₀₀</u>
4A	410	Ta	D	1/4 ac. Res.	0.5	0.76
4B	420	Ta	D	1/4 ac. Res.	0.5	0.76
4C	440	Vb, Ta	80% B, 20% D	1/4 ac. Res.	0.45	0.64
4D	450	Vb, Ta	90% B, 10% D	1/4 ac. Res.	0.45	0.62
4E	430, 460	Vb, Ta	80% B, 20% D	1/4 ac. Res.	0.45	0.64
4F	470	Vb, Ta	80% B, 20% D	1/4 ac. Res.	0.45	0.64

DETERMINE "I"

Assume $T_c = 15 \text{ min.}$ for all basins
 $\therefore I_2 = 3.83 \text{ in/hr}$ $I_{100} = 7.37 \text{ in/hr.}$

DETERMINE "A"

<u>BASIN</u>	<u>NODE</u>	<u>AREA (ac.)</u>
4A	410	1.02
4B	420	1.29
4C	440	8.20
4D	450	5.95
4E	430	3.83
	460	7.17



Date 3/22/98 Page 2 of

Project EVERGREEN ADDITION

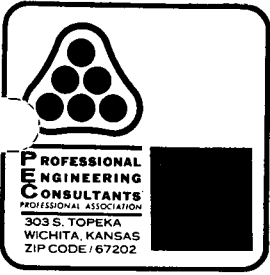
Item DRAINAGE PLAN SWS#4

DETERMINE "Q₂"

<u>BASIN</u>	<u>NODE</u>	<u>C₂</u>	<u>I₂</u>	<u>A</u>	<u>Q₂</u>
4A	410	0.5	3.83	1.02	2.0
4B	420	0.5	3.83	1.29	2.5
4C	440	0.45		8.20	14.1
4D	450	0.45		5.95	10.2
4E	430	0.45		3.83	6.6
	460	0.45		7.17	12.3
4F	470	0.45		3.83	2.53

DETERMINE "Q₁₀₀"

<u>BASIN</u>	<u>NODE</u>	<u>C₁₀₀</u>	<u>I₁₀₀</u>	<u>A</u>	<u>Q₁₀₀</u>
4A	410	0.76	7.37	1.02	5.7
4B	420	0.76	7.37	1.29	7.2
4C	440	0.64		8.20	38.7
4D	450	0.62		5.95	27.2
4E	430	0.64		3.83	18.1
	460	0.64		7.17	33.8
4F	470	0.64		7.37	2.53



Date 3/23/98 Page 3 of

Project EVERGREEN ADDITION

Item DRAINAGE PLAN SWS #4

II. INLET SIZING / FLOOD ROUTING - 2 YEAR

<u>BASIN</u>	<u>NODE</u>	<u>Inlet Condition</u>	<u>Q₂</u>	<u>Q_{max} (5' Inlet)</u>	<u>Q_{max} (10' Inlet)</u>	<u>Q_{intercept} *</u>	<u>Q_{bypass}</u>	<u>Use L²</u>
4A	410	Sump	2.0	11.0	22.0	2.0		5'
4B	420	Sump	2.5	11.0	22.0	2.5		5'
4E	430	Sump	6.6	11.0	22.0	6.6		5'
	460	Sump on grade (0.4%)	12.3	11.0	22.0	11.0	1.3 to (470)	5'
4F	470	Sump	4.4	11.0	22.0	4.4 + 1.3 = 5.7		5'
4C	440	Sump	14.1	11.0	22.0	14.1		10'
4D	450	Sump	10.2	11.0	22.0	10.2		5'

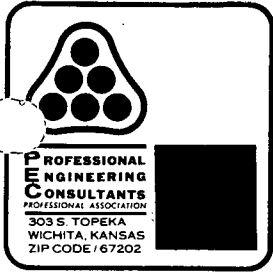
* - To be used in storm sewer sizing program

III. STREET FLOW

2-YEAR

<u>NODE</u>	<u>BASIN</u>	<u>Q₂</u>	<u>Distribution</u>	<u>Street Slope</u>	<u>d</u>	<u>d_{max}</u>	<u>Comment</u>
440	4C	14.1	90% (N) = 12.7	0.4%	0.54'	0.55'	OK OK

BY INSPECTION, ALL NODES ARE OK.



Date 3.23.98 Page 4 of _____
 Project EVERGREEN ADDITION
 Item DRAINAGE PLAN SWS#4

100-YEAR

* - See Design Aid

<u>Location</u>	<u>Contrib. Area</u>	<u>Q₁₀₀</u>	<u>Q_{pipe}</u>	<u>Q_{street}</u>	<u>Q_{max}*</u>	<u>Comment</u>
Approaching Nodes 410 & 430 from W	60% 4A	= 3.4	0			
	75% 4E	= 38.9	11.0			
	4F	= 11.9	5.7			
		<u>54.2</u>	<u>16.7</u>	37.5	48.9	OK. Std. Cb. 0.3' Wk Gr.

IV. OVERFLOW

Q₁₀₀ - Q₂ FLOW AT NODE 410 WILL BE ALLOWED TO OVERTOP CURB AND SPILL INTO ADJACENT PROPOSED LAKE.

Date: 03-23-1998
Time: 11:22:06

Input File: C:\OUTPUT\EVGRN4.STM

EVERGREEN ADDITION
SWS #4
DAR 3-23-98

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)	(In)	(Ft/Sec)	(Ft)	(Min)	(Min)
470	460	.00	.00	.0	15.00	3.83	5.70	15.00	3.83	5.70	5.70	3.23	35.00	.18	15.18
460	455	.00	.00	.0	15.00	3.83	11.00	15.18	3.81	10.94	16.64	5.30	140.00	.44	15.62
455	430	.00	.00	.0	.00	.00	.00	15.62	3.76	.00	16.64	5.30	170.00	.53	16.16
430	420	.00	.00	.0	15.00	3.83	6.60	16.16	3.70	6.38	23.02	4.69	35.00	.12	16.28
450	440	.00	.00	.0	15.00	3.83	10.20	15.00	3.83	10.20	10.20	3.25	35.00	.18	15.18
440	435	.00	.00	.0	15.00	3.83	14.10	15.18	3.81	14.02	24.22	4.93	270.00	.91	16.09
435	420	.00	.00	.0	.00	.00	.00	16.09	3.71	.00	24.22	4.93	270.00	.91	17.00
420	410	.00	.00	.0	15.00	3.83	2.50	17.00	3.61	2.36	49.13	5.11	40.00	.13	17.13
410	400	.00	.00	.0	15.00	3.83	2.00	17.13	3.60	1.88	51.01	4.06	100.00	.41	17.54

Date: 03-23-1998
Time: 11:22:06

Input File: C:\OUTPUT\EVGRN4.STM

EVERGREEN ADDITION
SWS #4
DAR 3-23-98

Storm Frequency = 2-Year

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

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.
400	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	161.5000	161.5000	.00
410	.00126	.1261	.0000	.0298	.0000	.0000	-.1138	.0422	161.5422	165.6000	4.06
420	.00238	.0954	.0000	.0027	.0000	.0311	.7354	.8646	162.4067	165.6000	3.19
430	.00315	.1102	.0000	.0188	.0000	.0000	.1745	.3036	162.7103	165.5000	2.79
435	.00349	.9417	.0000	.0000	.0189	.0000	.0175	.9781	163.3848	167.2000	3.82
440	.00349	.9417	.0000	.0214	.0000	.0818	.6818	1.7269	165.1117	166.2000	1.09
450	.00203	.0712	.0000	.0000	.0000	.0000	.0000	.0712	165.1828	166.2000	1.02
455	.00541	.9198	.0000	.0000	.0218	.0468	.0271	1.0155	163.7258	166.3000	2.57
460	.00541	.7575	.0000	.0274	.0000	.0058	.9051	1.6958	165.4216	166.5000	1.08
470	.00294	.1031	.0000	.0000	.0000	.0000	.0000	.1031	165.5247	166.5000	.98

RAINFALL INTENSITY TABLE

SEDGWICK COUNTY
KANSAS

THIS TABLE CONTAINS AVERAGE RAINFALL INTENSITIES
IN INCHES PER HOUR.

DURATION, HR:MIN	RETURN PERIOD						
	1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
3:15	0.54	0.69	0.90	1.05	1.26	1.42	1.58
3:30	0.51	0.65	0.85	0.99	1.19	1.34	1.49
3:45	0.48	0.61	0.80	0.94	1.12	1.27	1.41
4:00	0.46	0.58	0.76	0.89	1.07	1.21	1.34
4:15	0.44	0.55	0.73	0.85	1.02	1.15	1.28
4:30	0.42	0.53	0.70	0.81	0.98	1.10	1.23
4:45	0.40	0.51	0.67	0.78	0.94	1.06	1.18
5:00	0.38	0.49	0.64	0.75	0.90	1.02	1.13
5:15	0.37	0.47	0.62	0.72	0.87	0.98	1.09
5:30	0.35	0.45	0.60	0.70	0.83	0.94	1.05
5:45	0.34	0.44	0.58	0.67	0.81	0.91	1.01
6:00	0.33	0.42	0.56	0.65	0.78	0.88	0.98
6:30	0.31	0.40	0.52	0.61	0.73	0.83	0.92
7:00	0.30	0.38	0.50	0.58	0.69	0.78	0.87
7:30	0.28	0.36	0.47	0.55	0.66	0.74	0.83
8:00	0.27	0.34	0.45	0.52	0.62	0.70	0.78
8:30	0.26	0.33	0.43	0.50	0.60	0.67	0.75
9:00	0.25	0.31	0.41	0.48	0.57	0.64	0.72
9:30	0.24	0.30	0.39	0.46	0.55	0.62	0.69
10:00	0.23	0.29	0.38	0.44	0.52	0.59	0.66
10:30	0.22	0.28	0.36	0.42	0.50	0.57	0.63
11:00	0.21	0.27	0.35	0.41	0.49	0.55	0.61
11:30	0.21	0.26	0.34	0.39	0.47	0.53	0.59
12:00	0.20	0.25	0.33	0.38	0.45	0.51	0.57
13:00	0.19	0.24	0.31	0.36	0.43	0.48	0.53
14:00	0.18	0.22	0.29	0.34	0.40	0.45	0.50
15:00	0.17	0.21	0.27	0.32	0.38	0.43	0.47
16:00	0.16	0.20	0.26	0.30	0.36	0.40	0.45
17:00	0.15	0.19	0.25	0.29	0.34	0.38	0.43
18:00	0.15	0.18	0.24	0.27	0.33	0.37	0.41
19:00	0.14	0.18	0.23	0.26	0.31	0.35	0.39
20:00	0.14	0.17	0.22	0.25	0.30	0.34	0.37
21:00	0.13	0.16	0.21	0.24	0.29	0.32	0.36
22:00	0.13	0.16	0.20	0.23	0.28	0.31	0.34
23:00	0.12	0.15	0.19	0.22	0.27	0.30	0.33
24:00	0.12	0.15	0.19	0.22	0.26	0.29	0.32

RAINFALL INTENSITY TABLE

SEDGWICK COUNTY
KANSAS

THIS TABLE CONTAINS AVERAGE RAINFALL INTENSITIES
IN INCHES PER HOUR.

DURATION, HR:MIN	RETURN PERIOD						
	1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
0:46	1.67	2.04	2.58	2.96	3.50	3.92	4.34
0:47	1.65	2.01	2.55	2.92	3.46	3.87	4.29
0:48	1.63	1.98	2.51	2.88	3.41	3.82	4.23
0:49	1.60	1.96	2.48	2.85	3.37	3.78	4.18
0:50	1.58	1.93	2.45	2.81	3.33	3.73	4.13
0:51	1.56	1.91	2.42	2.78	3.29	3.68	4.08
0:52	1.54	1.88	2.39	2.74	3.25	3.64	4.03
0:53	1.52	1.86	2.36	2.71	3.21	3.60	3.98
0:54	1.50	1.84	2.33	2.68	3.17	3.55	3.94
0:55	1.48	1.81	2.30	2.65	3.13	3.51	3.89
0:56	1.46	1.79	2.28	2.62	3.10	3.47	3.85
0:57	1.45	1.77	2.25	2.59	3.06	3.43	3.80
0:58	1.43	1.75	2.23	2.56	3.03	3.40	3.76
0:59	1.41	1.73	2.20	2.53	3.00	3.36	3.72
1:00	1.39	1.71	2.18	2.50	2.96	3.32	3.68
1:05	1.32	1.62	2.06	2.37	2.81	3.15	3.49
1:10	1.25	1.53	1.96	2.25	2.67	3.00	3.33
1:15	1.18	1.46	1.87	2.15	2.55	2.86	3.17
1:20	1.13	1.39	1.78	2.05	2.44	2.74	3.04
1:25	1.07	1.33	1.70	1.97	2.34	2.63	2.91
1:30	1.03	1.27	1.63	1.89	2.24	2.52	2.80
1:35	0.98	1.22	1.57	1.81	2.16	2.43	2.69
1:40	0.94	1.17	1.51	1.75	2.08	2.34	2.60
1:45	0.91	1.13	1.46	1.69	2.01	2.26	2.51
1:50	0.87	1.09	1.41	1.63	1.94	2.18	2.42
1:55	0.84	1.05	1.36	1.57	1.88	2.11	2.35
2:00	0.81	1.02	1.32	1.52	1.82	2.05	2.28
2:05	0.79	0.98	1.28	1.48	1.76	1.99	2.21
2:10	0.76	0.95	1.24	1.43	1.71	1.93	2.14
2:15	0.74	0.92	1.20	1.39	1.67	1.88	2.08
2:20	0.72	0.90	1.17	1.36	1.62	1.82	2.03
2:25	0.70	0.87	1.14	1.32	1.58	1.78	1.98
2:30	0.68	0.85	1.11	1.29	1.54	1.73	1.93
2:35	0.66	0.83	1.08	1.25	1.50	1.69	1.88
2:40	0.64	0.81	1.05	1.22	1.46	1.65	1.83
2:45	0.62	0.79	1.03	1.19	1.43	1.61	1.79
2:50	0.61	0.77	1.00	1.17	1.40	1.57	1.75
2:55	0.59	0.75	0.98	1.14	1.37	1.54	1.71
3:00	0.58	0.73	0.96	1.12	1.34	1.51	1.68

RAINFALL INTENSITY TABLE

SEDGWICK COUNTY
KANSAS

THIS TABLE CONTAINS AVERAGE RAINFALL INTENSITIES
IN INCHES PER HOUR.

DURATION, HR:MIN	RETURN PERIOD						
	1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
0:05	4.77	5.52	6.56	7.32	8.44	9.32	10.20
0:06	4.53	5.26	6.27	7.02	8.11	8.96	9.81
0:07	4.33	5.04	6.03	6.76	7.82	8.65	9.48
0:08	4.16	4.85	5.82	6.52	7.55	8.36	9.17
0:09	4.00	4.67	5.61	6.30	7.30	8.09	8.87
0:10	3.85	4.50	5.42	6.08	7.06	7.82	8.58
0:11	3.71	4.34	5.23	5.88	6.83	7.56	8.30
0:12	3.58	4.19	5.06	5.69	6.60	7.32	8.04
0:13	3.45	4.05	4.90	5.51	6.40	7.10	7.79
0:14	3.34	3.92	4.75	5.34	6.21	6.89	7.57
0:15	3.23	3.80	4.61	5.19	6.04	6.70	7.36
0:16	3.13	3.69	4.48	5.05	5.88	6.53	7.17
0:17	3.03	3.58	4.36	4.92	5.73	6.37	7.00
0:18	2.94	3.48	4.25	4.80	5.60	6.22	6.84
0:19	2.86	3.39	4.14	4.69	5.47	6.09	6.70
0:20	2.78	3.30	4.05	4.58	5.35	5.96	6.56
0:21	2.70	3.21	3.95	4.48	5.24	5.84	6.43
0:22	2.63	3.14	3.87	4.39	5.14	5.72	6.30
0:23	2.56	3.06	3.78	4.30	5.04	5.61	6.19
0:24	2.50	2.99	3.71	4.21	4.94	5.51	6.07
0:25	2.44	2.93	3.63	4.13	4.85	5.41	5.97
0:26	2.38	2.86	3.56	4.05	4.76	5.31	5.86
0:27	2.33	2.80	3.49	3.98	4.68	5.22	5.76
0:28	2.28	2.75	3.43	3.91	4.59	5.13	5.66
0:29	2.23	2.69	3.36	3.84	4.52	5.04	5.57
0:30	2.19	2.64	3.30	3.77	4.44	4.96	5.48
0:31	2.14	2.59	3.24	3.71	4.37	4.88	5.39
0:32	2.10	2.54	3.19	3.64	4.30	4.80	5.31
0:33	2.06	2.50	3.14	3.58	4.23	4.73	5.22
0:34	2.02	2.45	3.08	3.53	4.16	4.65	5.14
0:35	1.99	2.41	3.03	3.47	4.10	4.58	5.07
0:36	1.95	2.37	2.99	3.42	4.03	4.51	4.99
0:37	1.92	2.33	2.94	3.36	3.97	4.45	4.92
0:38	1.89	2.30	2.89	3.31	3.91	4.38	4.84
0:39	1.86	2.26	2.85	3.27	3.86	4.32	4.77
0:40	1.83	2.23	2.81	3.22	3.80	4.26	4.71
0:41	1.80	2.19	2.77	3.17	3.75	4.20	4.64
0:42	1.77	2.16	2.73	3.13	3.70	4.14	4.58
0:43	1.75	2.13	2.69	3.08	3.65	4.08	4.52
0:44	1.72	2.10	2.65	3.04	3.60	4.03	4.46
0:45	1.70	2.07	2.62	3.00	3.55	3.97	4.40

Land Use or
Surface Characteristics

Percent
Impervious

Frequency

Soil Group D

		<u>2</u>	<u>5</u>	<u>10</u>	<u>100</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.

Land Use or Face Characteristics	Percent Impervious	Frequency			
		2	5	10	100
<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
Undeveloped Urban Areas:					
Offsite Flow Analysis (when land use not defined)	45	0.52	0.54	0.59	0.68
8. Streets:					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
9. Drive, Parking Lots and Walks:					
	96	0.87	0.87	0.88	0.89
10. Roofs:					
	90	0.80	0.85	0.90	0.93
11. Urban Lawn Areas (See Note No. 1 below):					
<u>Soil Group A</u>					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
<u>Soil Group B</u>					
Slope less than 1%	00	0.16	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
<u>Soil Group C</u>					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%	00	0.28	0.31	0.39	0.55

ATTACHMENT D

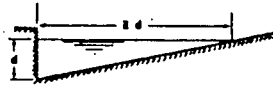
DRAINAGE CRITERIA

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>
1. Business:					
Lowntown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
2. Residential:					
<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

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS



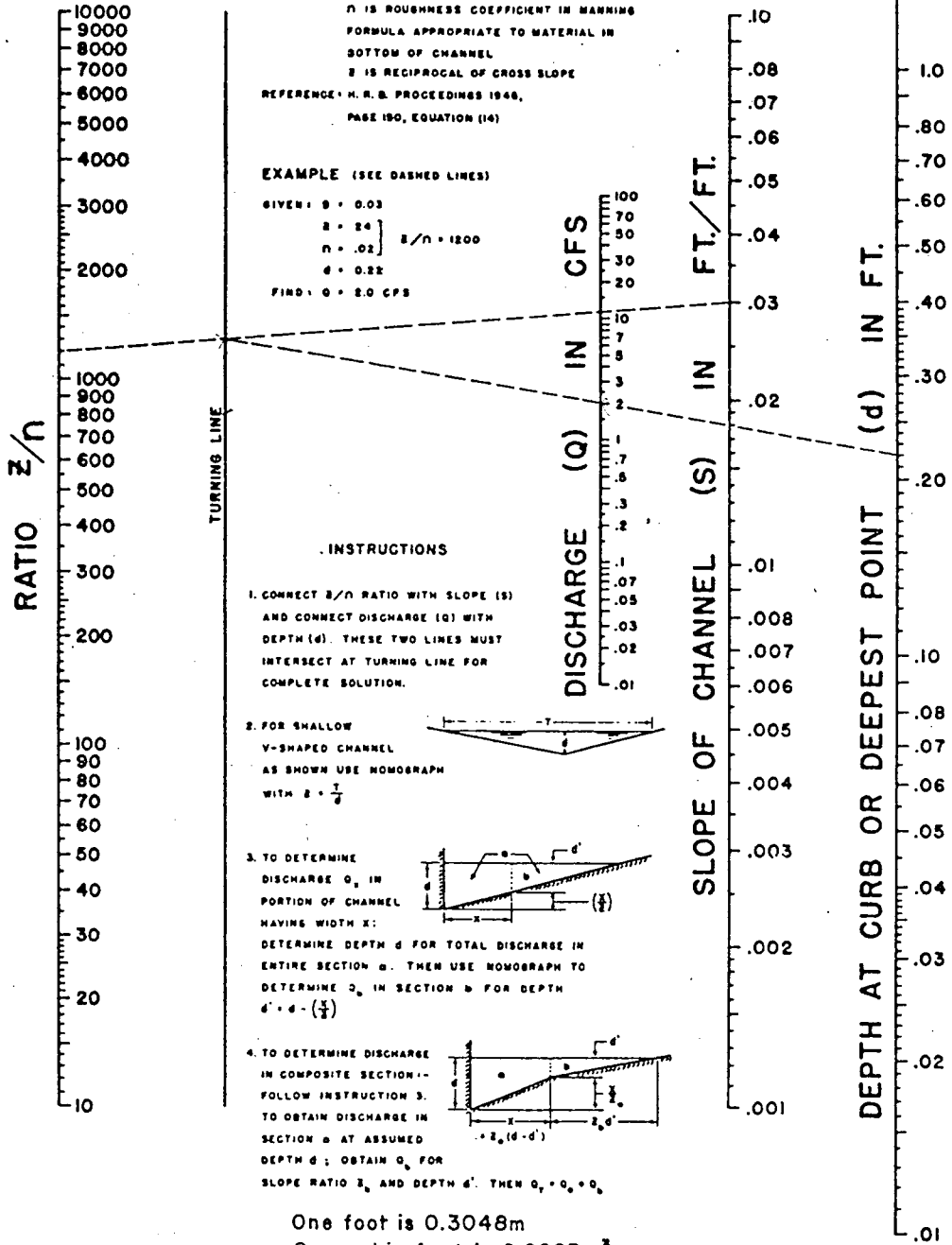
EQUATION: $Q = 0.36 \left(\frac{Q}{S}\right)^{2/3} d^{2/3}$

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 DASHED LINES)

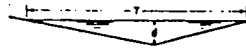
GIVEN: $S = 0.03$
 $Z = 24$
 $n = .02$ } $Z/n = 1200$
 $d = 0.22$
 FIND: $Q = 2.0$ CFS



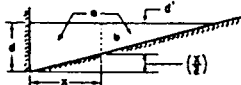
INSTRUCTIONS

1. CONNECT Z/n RATIO WITH SLOPE (S) AND CONNECT DISCHARGE (Q) WITH DEPTH (d). THESE TWO LINES MUST INTERSECT AT TURNING LINE FOR COMPLETE SOLUTION.

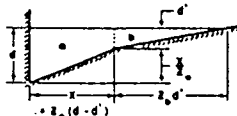
2. FOR SHALLOW V-SHAPED CHANNEL AS SHOWN USE NOMOGRAPH WITH $Z = \frac{1}{S}$



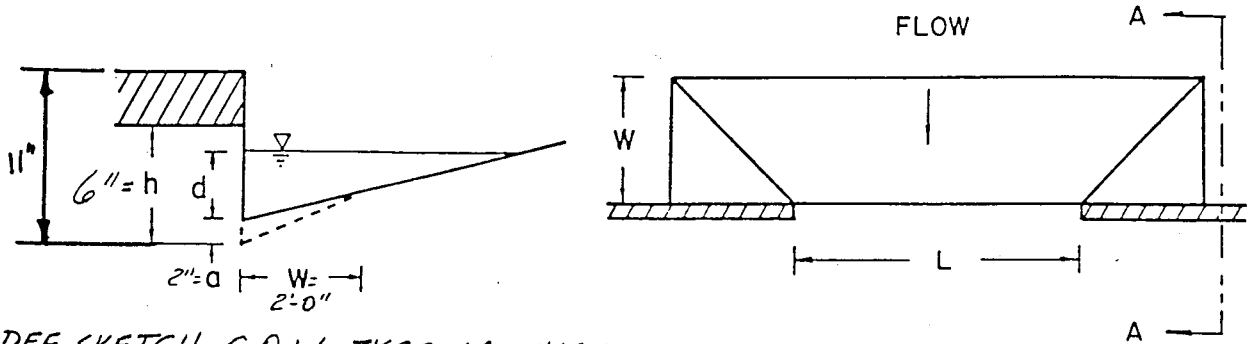
3. TO DETERMINE DISCHARGE Q_1 IN PORTION OF CHANNEL HAVING WIDTH X: DETERMINE DEPTH d FOR TOTAL DISCHARGE IN ENTIRE SECTION a . THEN USE NOMOGRAPH TO DETERMINE Q_1 IN SECTION b FOR DEPTH $d' = d \cdot \left(\frac{X}{a}\right)$



4. TO DETERMINE DISCHARGE IN COMPOSITE SECTION -- FOLLOW INSTRUCTION 3. TO OBTAIN DISCHARGE IN SECTION a AT ASSUMED DEPTH d ; OBTAIN Q_1 FOR SLOPE RATIO Z_1 AND DEPTH d' . THEN $Q = Q_1 + Q_2$



One foot is 0.3048m
 One cubic foot is 0.0283m³



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

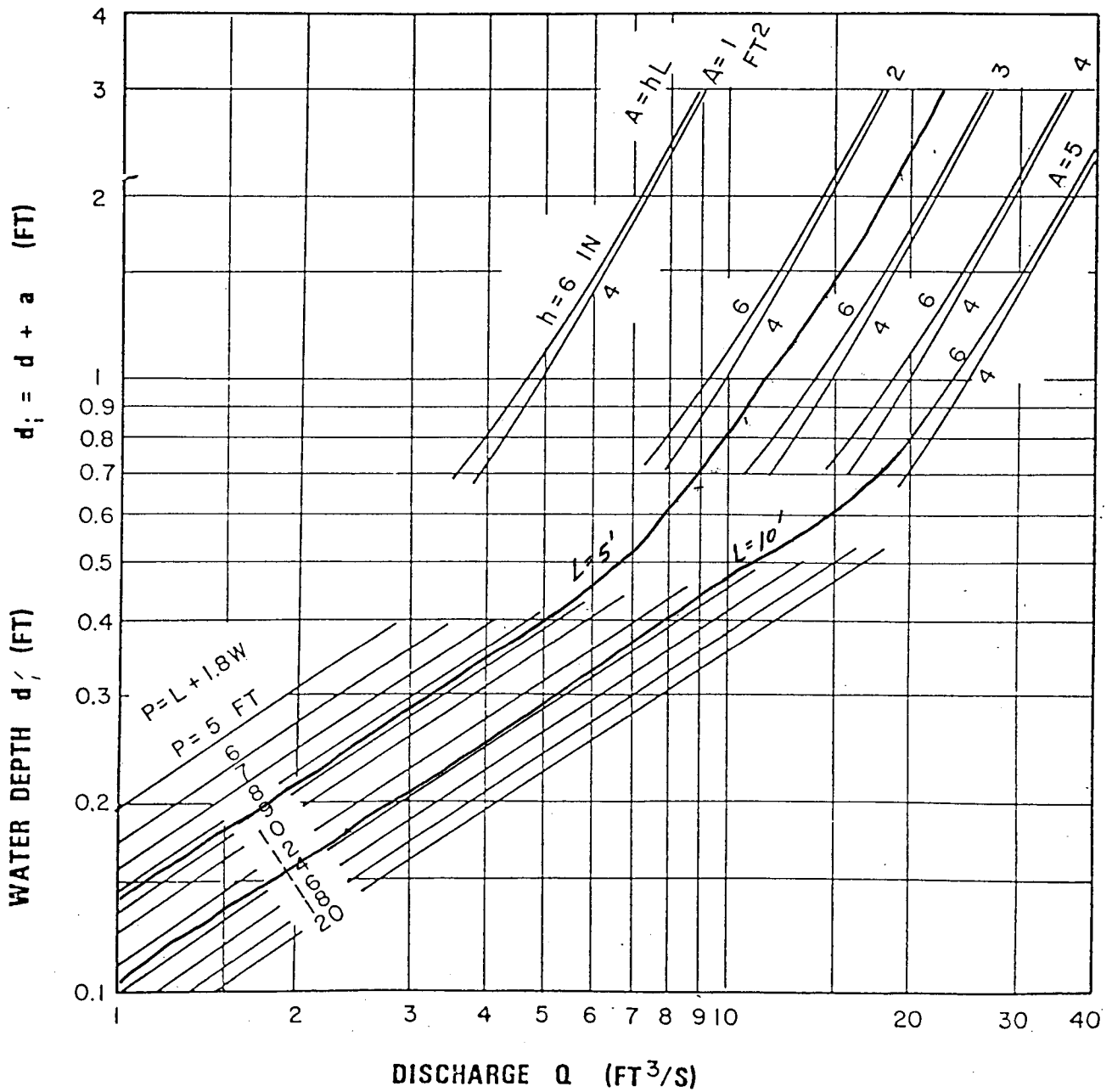
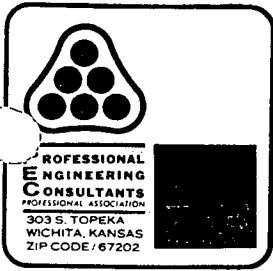


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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



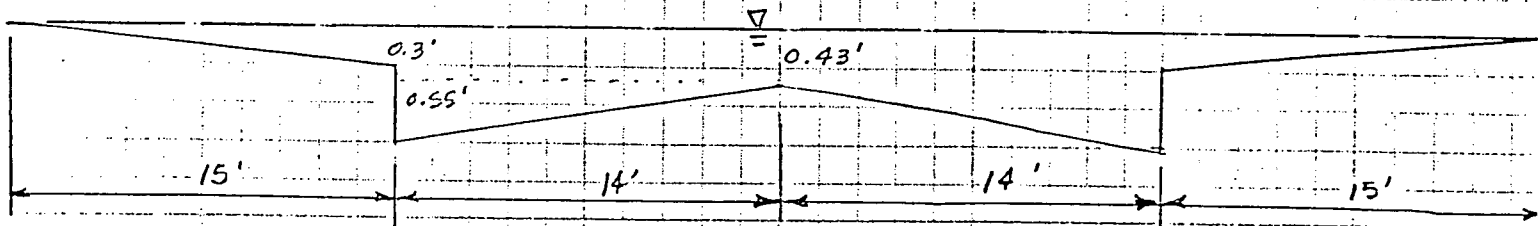
Date _____ Page _____ of _____

Project _____

Item _____

Determine Capacities of Standard Curb Streets w/
Various Walk Grades for 100-year storm analysis
(58' R-O-W)

0.3' WALK GRADE



$$n = \frac{(2 \times 14.5 \times 0.03) + (2 \times 3.05 \times 0.013) + (2 \times 12 \times 0.016)}{59.1}$$

$$= \frac{(0.87) + (0.0793) + (0.384)}{59.1} = \frac{1.3333}{59.1} = 0.0226$$

$$A = (2 \times \frac{1}{2} \times 15 \times 0.3) + (28 \times 0.43) + (2 \times \frac{1}{2} \times 14 \times 0.42)$$

$$= (4.5) + (12.04) + (5.88)$$

$$= 22.42$$

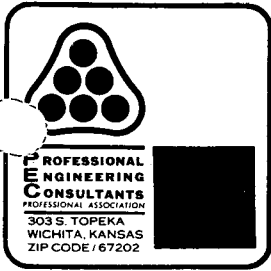
$$p = 59.1$$

$$R = A/p = 22.42/59.1 = 0.379397 \quad R^{2/3} = 0.52404$$

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

$$Q = \frac{1.486}{0.0226} \times 22.42 \times 0.52404 \times S^{1/2}$$

$$Q = 772.5 \sqrt{S}$$



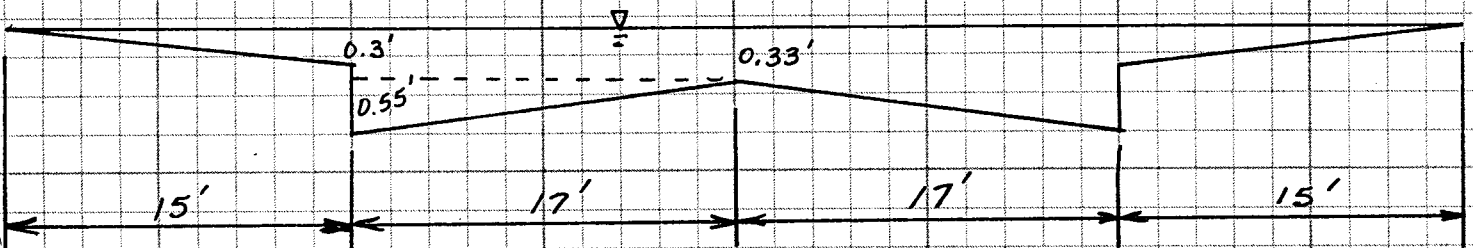
Date _____ Page _____ of _____

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Item _____

DETERMINE CAPACITIES OF STANDARD CURB STREETS W/
 VARIOUS WALK GRADES FOR 100-YEAR STORM ANALYSIS
 (64' R-O-W)

0.3' WALK GRADE



$$\begin{aligned}
 m &= \frac{(2 \times 14.5 \times 0.03) + (2 \times 3.05 \times 0.013) + 2(15 \times 0.016)}{65.1} \\
 &= \frac{(0.87) + (0.0793) + (0.48)}{65.1} \\
 &= .02196
 \end{aligned}$$

$$\begin{aligned}
 A &= (2 \times \frac{1}{2} \times 15 \times 0.3) + (34 \times 0.33) + (2 \times \frac{1}{2} \times 17 \times 0.52) \\
 &= (4.5) + (11.22) + (8.84) \\
 &= 24.56 \text{ s.f.}
 \end{aligned}$$

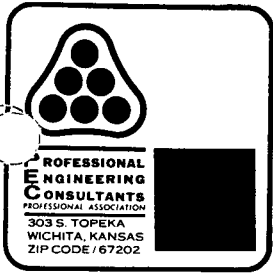
$$P = 65.1$$

$$R = \frac{24.56}{65.1} = 0.377 \quad R^{2/3} = 0.522$$

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

$$Q = \frac{1.486}{.02196} \times 24.56 \times 0.522 \times S^{1/2}$$

$$Q = 867.5 \times S^{1/2}$$

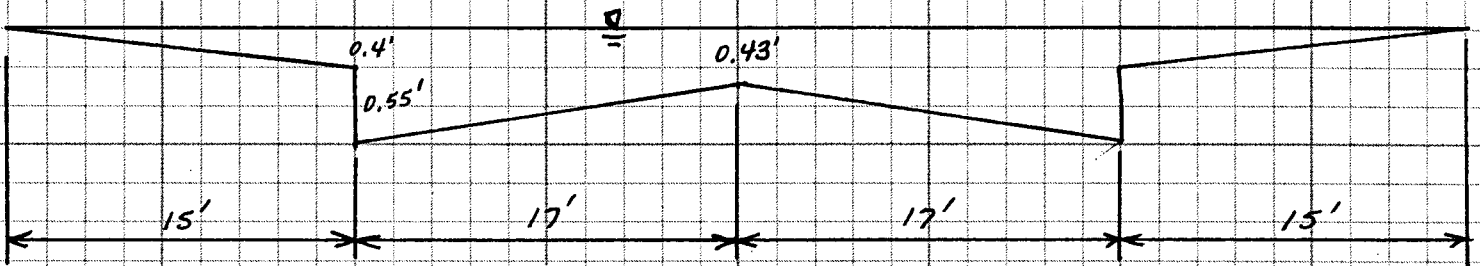


Date _____ Page _____ of _____

Project _____

Item _____

0.4' WALK-GRADE



$$M = \frac{(2 \times 14.5 \times .03) + (2 \times 3.05 \times .013) + (2 \times 15 \times .016)}{65.1}$$

$$= .02196$$

$$A = (2 \times \frac{1}{2} \times 15 \times 0.4) + (34 \times .43) + (2 \times \frac{1}{2} \times 17 \times 0.52)$$

$$= 6.0 + 14.62 + 8.84$$

$$= 29.46$$

$$P = 65.1'$$

$$R = \frac{29.46}{65.1} = 0.45243 \quad R^{2/3} = 0.5894$$

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

$$= \frac{1.486}{.02196} \times 29.46 \times 0.5894 \times \sqrt{S}$$

$$Q = 1175.0 \sqrt{S}$$