PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

OXFORD ADDITION
TO WICHITA, SEDGWICK COUNTY, KANSAS

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

MAY 18, 1990

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ZIP CODE 67202

Date MAY 18 1990

Project OXFORD ADDITION

Item DRAINAGE PLAN - INTRODUCTION

INTRODUCTION

OXFORD ADDITION IS A PROPOSED REPLAT OF LOT 2, BLOCK 1, WINDEMERE 2ND ADDITION. THE TALLGRASS C.U.P. HAS BEEN AMENDED TO ALLOW SINGLE-FAMILY USES.

OFF-SITE DRAINAGE ENTERS OXFORD ADDITION FROM THE WEST (SILVERLEAF AREA) AND THE NORTH/EAST (TALLGRASS GOLF COURSE, OXFORD ST, WINDEMERE APARTMENTS)

THIS PLAN ADDRESSES THE INTERCONNECTION OF EXISTING AND PROPOSED STORM SEWER SYSTEMS WITH THE FUTURE OXFORD ADDITION STORM SEWERS AND ALSO ADDRESSES THE ROUTING OF A MAJOR STORM THROUGH THE AREA.

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Date May 15, 1990 Page 1 of 10

Project Oxford Addition

Item Drainage Plan System 1

I HYDROLOGY

Use Rational Method $Q = cIA$

Determine "c"

Node	Soil Type	Hyd. Group	Land Use	c_2	c_{100}
105	Connection to SWS.				
104	Manhole				
103	Rd	D	Res; 1/8 Ac Lot	0.57	0.79
102	Rd	D	Res; 1/8 Ac. Lot	0.57	0.79
101	Manhole				
100	Headwall				

Determine "I"

Node	t_c	I_2	I_{100}
103	15	3.83	7.37
102	15	3.83	7.37

Determine "A"

Node	Plan. Units	Area SF	Area Ac.
105	Connection to SWS.		
104	Manhole		
103	31.92	79,800	1.83
102	36.36	90,400	2.09
101	Manhole		
100	Headwall		

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Project Oxford Addition

Item Drainage Plan System 1

Determine "Q_2"

Node	C_2	I_2	A	Q_2
105	Connection to SWS			
104	Manhole			
103	0.57	3.83	1.83	4.0
102	0.57	3.83	2.09	4.6
101	Manhole			
100	Headwall			

Determine "Q_{100}"

Node	C_{100}	I_{100}	A	Q_{100}
105	Connection to SWS			
104	Manhole			
103	0.79	7.37	1.83	10.7
102	0.79	7.37	2.09	12.2
101	Manhole			
100	Headwall			

II INLET SIZING (2-yr)

Node	Inlet Condition	Q_2	Q_{max} ≠ (5' inlet)	Q_{max} ≠ (10' inlet)	$Q_{intercept}$ Δ	Use
105	Connection to SWS.				32.1*	
104	Manhole				34.8**	
103	Sump	4.0	11.0	22.0	4.0	5'
102	Sump	4.6	11.0	22.0	4.6	5'
101	Manhole					
100	Headwall					

≠ based on Type 1A inlet, ponding @ top of standard curb.

* proposed SWS in Oxford Street being designed by MKEC, includes drainage from golf course, Oxford St, proposed Windemere Apartments.

** existing 42" SWS from Silverleaf, etc.

Δ input Q for "Storm" program.

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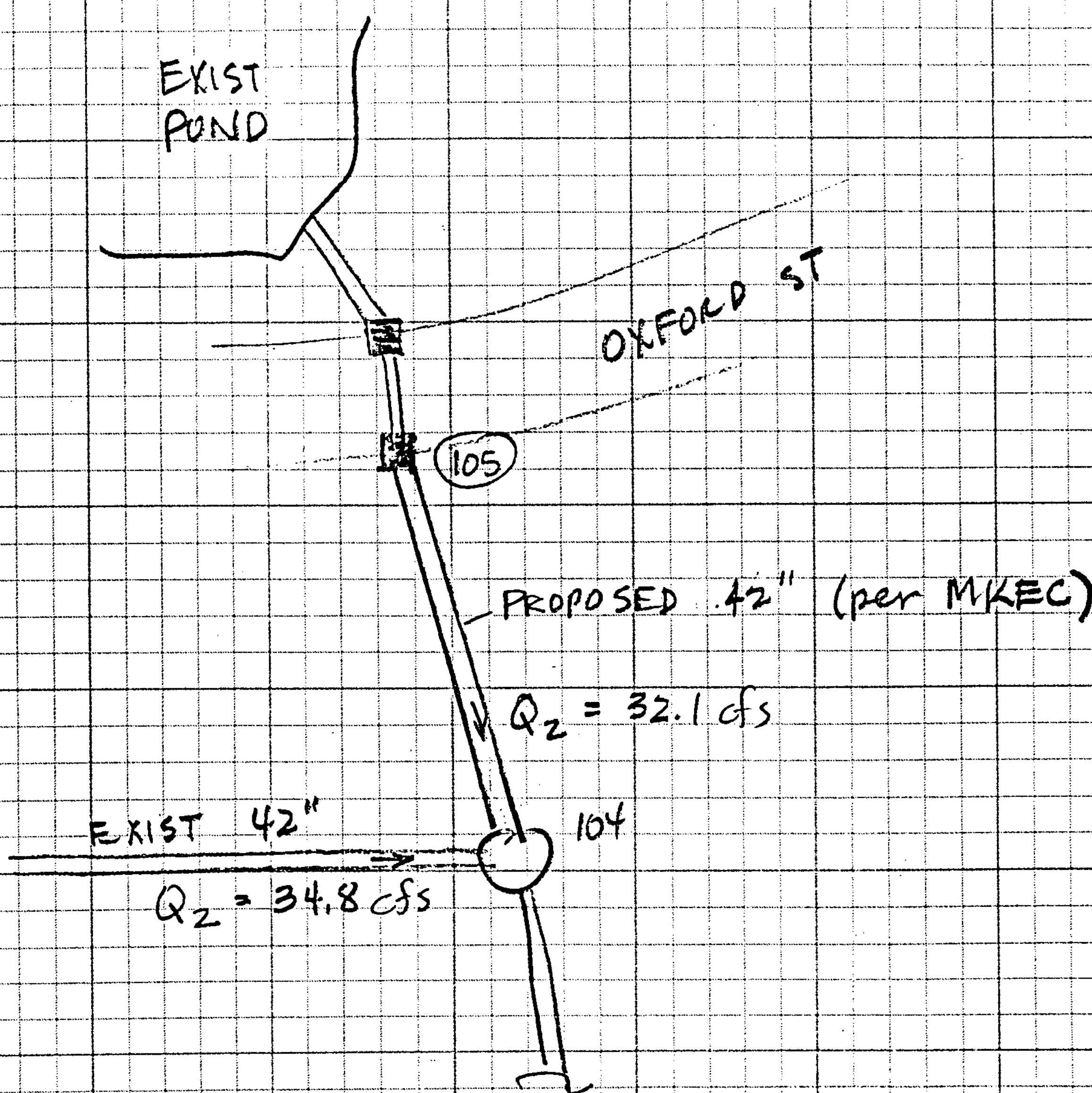
Date May 18, 1990

Project Oxford Addition

Item Drainage Plan System 1



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Item Drainage Plan System 1

III STREET FLOW

(2yr)

Node	Q_2	Distribution	street slope	d	dmax	Comm...
105	connection to SWS (MKEC)					
104	Manhole					
103	4.0	80% (S) = 3.2	0.32%	0.34'	0.55'	OK
		20% (N) = 0.8	0.50%	0.18'	0.55'	OK
102	4.6	70% (S) = 3.2	0.32%	0.34'	0.55'	OK
		30% (N) = 1.4	0.50%	0.23'	0.55'	OK
101	Manhole					
100	Headwall					

(100 Yr) $Q_{street} = Q_{100} - Q_{pipe}$

Location	Contrib. Area	Q_{100}	Q_{pipe}	Q_{street}	street slope	Q_{max}	Commen...
Approaching 103 + 102	80% 103 =	8.6					
	70% 102 =	8.5					
from S.		15.1	0.0	15.1	0.32%	43.7	OK std CB 0.3' WKG
Approaching 103 + 102 from N.	20% 103 =	2.1					
	30% 102 =	3.7					
	Windemere/Oxford St =	95.6					
	Silverleaf =	92.8					
		194.2	66.9	127.3	0.50%	141.1	OK std CB 0.7' WKG

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Item Drainage Plan System 1

IV OVER-FLOW SWALE

Design for $Q_{100} - Q_2$

Q_{100} =

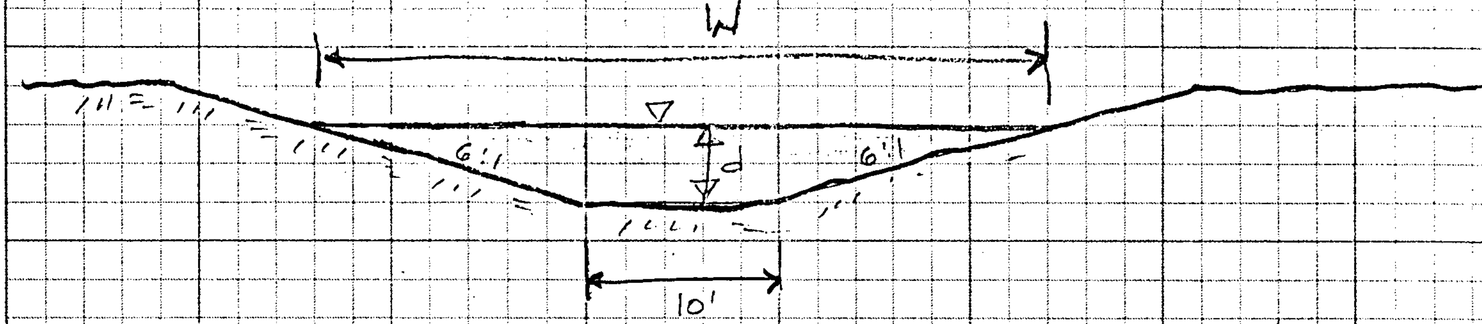
Node 103	10.7
Node 102	12.2
Oxford St/ Windemere	95.6
Silverleaf	92.6
	211.1

Q_2 = Qpipe

Node 103	=	4.0
Node 102	=	4.6
Oxford St/ Windemere	=	32.1
Silverleaf	=	34.8
		75.5

$Q_{swale} = 211.1 - 75.5 = 135.6$ cfs.

Channel section:



Use Manning's Equation $Q = \frac{1.486}{n} AR^{2/3} s^{1/2}$

where $Q = 135.6$
$n = 0.030$
$s = 0.01$ '/'

$$135.6 = \frac{1.486}{0.03} AR^{2/3} (0.01)^{1/2}$$

$$135.6 = 49.53\ AR^{2/3}\ 0.1$$

$$AR^{2/3} = 27.38$$

Trial & Error solution for d:

Assumed d	A	P	R	$R^{2/3}$	$AR^{2/3}$	
1.0	16.0	22.17	0.72	0.80	12.87	
1.1	18.26	23.38	0.78	0.85	15.49	
1.4	25.76	27.03	0.95	0.97	24.95	
1.5	28.50	28.24	1.01	1.01	28.67	← USE

$d = 1.5$

$V = Q/A = \frac{135.6}{28.5} = 4.7$ OK

$W = 10' + 2(1.5 \times 6) = 28'$

```
100 j,  202.5000  100    3    6    5
110 t,oxford addition
120 t,drainage plan
130 t,store water sewer system analysis
140 i,  105     0.70    24.50     0.00     0.00    32.10    44.00   205.10
150 i,  104     0.70    15.90     0.00     0.00    34.90    15.00   206.00
160 i,  103     0.57     1.83     0.00     0.00     4.00    15.00   204.40
170 i,  102     0.57     2.09     0.00     0.00     4.60    15.00   204.42
180 m,  101   203.00
190 m,  100   202.50
200 p,  105  104   220.00   42 0.013  20.00   0.00
210 p,  104  103   290.00   48 0.013   0.00   0.00
220 p,  103  102    50.00   48 0.013   0.00   0.00
230 p,  102  101   500.00   54 0.013  10.00   0.00
240 p,  101  100    50.00   54 0.013   0.00   0.00
250 e
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Date: 05-18-1998
Time: 13:43:44

Input File: oxford1

oxford addition
drainage plan
storm water sewer system analysis

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

Node to Node		C	Area (Ac)	Slope (%)	Length (Ft)	TC(0) (Min)	I(0) (In/Hr)	Q(0) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
		Tributary Area							Hydrology Summation				Conduit Data				
105	104	0.70	24.50	0.00	0.0	44.00	2.15	32.10	44.00	2.15	32.10	32.10	42"	3.34	220.00	1.10	45.10
104	103	0.70	15.90	0.00	0.0	15.00	4.06	34.80	45.10	2.11	18.08	50.18	48"	3.99	290.00	1.21	46.31
103	102	0.57	1.83	0.00	0.0	15.00	4.06	4.00	46.31	2.07	2.04	52.21	48"	4.16	50.00	0.20	46.51
102	101	0.57	2.09	0.00	0.0	15.00	4.06	4.60	46.51	2.06	2.33	54.55	54"	3.43	500.00	2.43	48.94
101	100	0.00	0.00	0.00	0.0	0.00	0.00	0.00	48.94	1.98	0.00	54.55	54"	3.43	50.00	0.24	49.18

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Time: 13:43:44

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oxford addition
drainage plan
storm water sewer system analysis

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
105	0.00102	0.2240	0.0000	0.0000	0.0000	0.0000	0.0000	0.2240	203.8820	205.1000	1.22
104	0.00122	0.3539	0.0000	0.0975	0.0000	0.0142	0.2672	0.6428	203.6581	206.0000	2.34
103	0.00132	0.0661	0.0000	0.0021	0.0000	0.0000	0.0474	0.1156	203.0153	204.4000	1.38
102	0.00077	0.3847	0.0000	0.0171	0.0000	0.0000	-0.0600	0.3418	202.8993	204.4000	1.50
101	0.00077	0.0385	0.0000	0.0000	0.0091	0.0065	0.0039	0.0580	202.5580	203.0000	0.44
100	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	202.5000	202.5000	0.00

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Item Drainage Plan System 200

I HYDROLOGY Use Rational Method $Q = cIA$

Determine "c"

Node	Soil Type	Hyd. Group	Land Use	C_2	C_{100}
203	Rd	D	Res; 1/8 Ac.	0.57	0.79
202	Rd	D	Res; 1/3 Ac.	0.57	0.79
201	Manhole				
200	Headwall				

Determine "I"

Node	t_c	I_2	I_{100}
203	15	3.83	7.37
202	15	3.83	7.37
201	Manhole		
200	Headwall		

Determine "A"

Node	Plan. Units	Area (SF)	Area (Ac.)
203	37.84	94,600	2.17
202	33.92	84,800	1.95
201	Manhole		
200	Headwall		

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Date May 17, 1990

Project Oxford Addition

Item Drainage Plan System 2

Determine "Q_2"

Node	C_2	I_2	A	Q_2
203	0.57	3.83	2.17	4.7
202	0.57	3.83	1.95	4.3
201	Manhole			
200	Headwall			

Determine "Q_{100}"

Node	C_{100}	I_{100}	A	Q_{100}
203	0.79	737	2.17	12.6
202	0.79	7.37	1.95	11.4
201	Manhole			
200	Headwall			

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Project Oxford Addition
Item Drainage Plan System 2

II INLET SIZING (100-yr)

Node	Inlet Condition	Q_{100}	Q_{max} ≠ (5' inlet)	Q_{max} ≠ (10' inlet)	Use: Inlet Lengt
203	SUMP	12.6	12.0	24.0	5'
202	SUMP	11.4	12.0	24.0	5'
201	Manhole				
200	Headwall				

≠ based on Type 1A inlet, Ponding 0.3' above top of roll curb.

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Date May 17, 1990

Project Oxford Addition

Item Drainage Plan

III STREET FLOW

2 Yr

Node	Q_2	Distribution	street slope	d	dmax	Comment
203	4.7	50% (W) = 2.4	0.32%	0.29'	0.30'	OK
		50% (E) = 2.4	0.32%	0.29'	0.30'	OK
202	4.3	50% (W) = 2.2	0.32%	0.28'	0.30'	OK
		50% (E) = 2.2	0.32%	0.28'	0.30'	OK
201	Manhole					
200	Headwall					

100-Yr

Location	Contrib. Area	Q_{100}	Q_{pipe}	Q_{street}	street slope	Q_{max}	Comment
Approaching 203 + 202 from E.	50% 203 =	6.3					
	50% 202 =	5.7					
		12.0	0.0	12.0	0.32%	22.8	OK Roll Cb 0.3' wk. G
Approaching 203 & 202 from W	50% 203 =	6.3					
	50% 202 =	5.7					
		12.0	0.0	12.0	0.32%	22.8	OK Roll Cb. 0.3' wk G

5/7

```
100 j,  202.5000  200    3    4    3
110 t,oxford addition
120 t,drainsage plan
130 t,storm water sewer system analysis
140 i,  203     0.79     2.17     0.00     0.00    12.60    15.00   203.80
150 i,  202     0.79     1.95     0.00     0.00    11.40    15.00   203.80
160 m,  201   202.50
170 m,  200   202.50
180 p,  203  202    35.00   24 0.013   0.00   0.00
190 p,  202  201   240.00   30 0.013   0.00   0.00
200 p,  201  200    20.00   30 0.013  90.00   0.00
210 e
```

6/7

Date: 05-18-1993
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oxford addition
drainage plan
storm water sewer system analysis

Storm Frequency = 100-Year

* * * HYDROLOGY * * *

Node to Node		Tributary Area: C	Area (Ac)	Slope (%)	Length (Ft)	TC(0) (Min)	I(0) (In/Hr)	Q(0) (CFS)	Hydrology Summation: TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Conduit Data: Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
203	202	0.79	2.17	0.00	0.0	15.00	8.97	12.60	15.00	8.97	12.60	12.60	24"	4.01	35.00	0.15	15.15
202	201	0.79	1.95	0.00	0.0	15.00	8.97	11.40	15.15	8.94	11.36	23.96	30"	4.88	240.00	0.82	15.97
201	200	0.00	0.00	0.00	0.0	0.00	0.00	0.00	15.97	8.76	0.00	23.96	30"	4.88	20.00	0.07	16.03

Date: 05-13-1990
Time: 08:52:17

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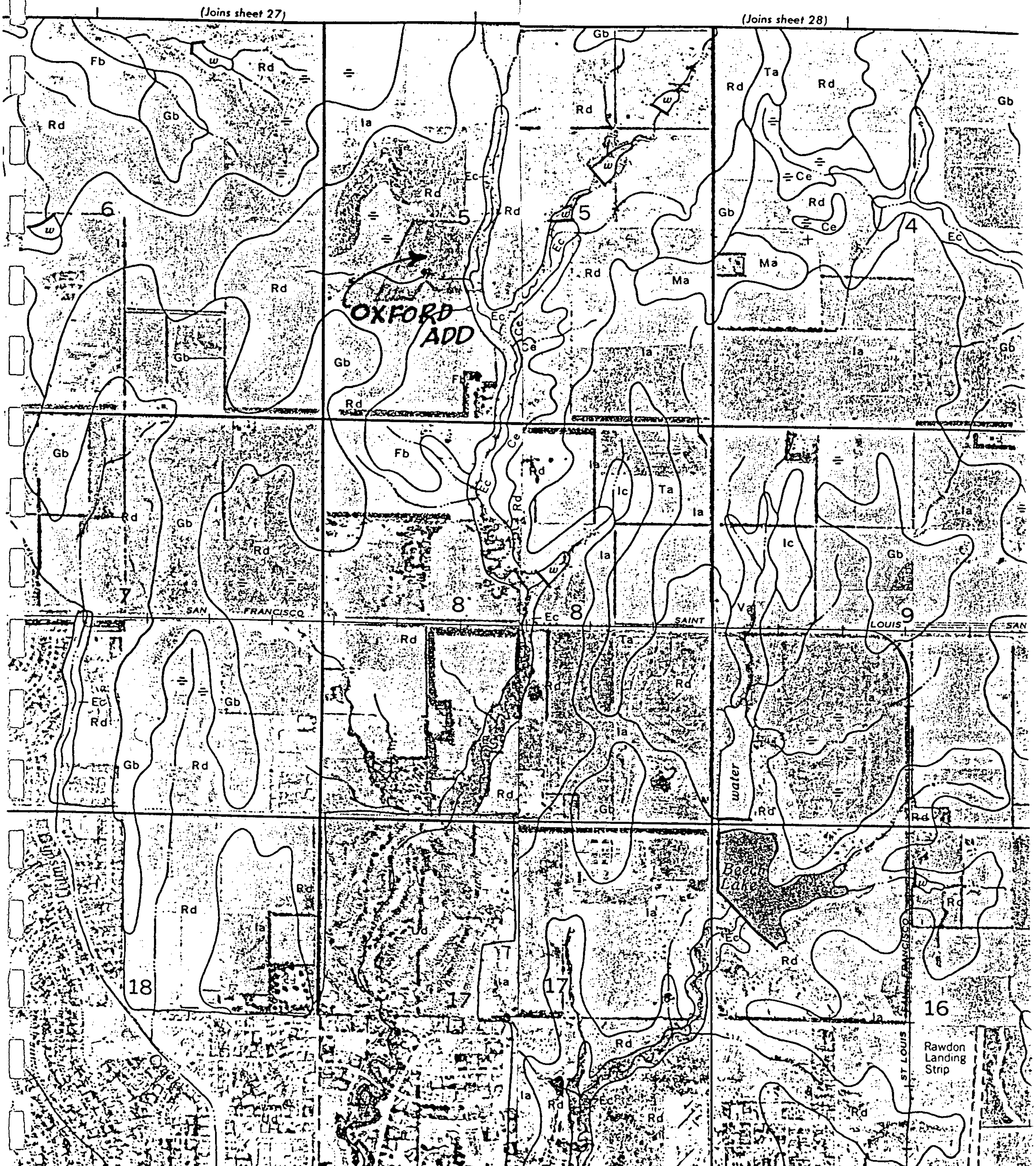
oxford addition
drainage plan
storm water sewer system analysis

Storm Frequency = 100-Year

* * * HYDRAULICS * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
203	0.00310	0.1036	0.0000	0.0000	0.0000	0.0000	0.0000	0.1086	204.0726	203.8000	-0.27
202	0.00341	0.8188	0.0000	0.0120	0.0000	0.0000	0.5294	1.3602	203.9640	203.8000	-0.16
201	0.00341	0.0682	0.0000	0.0000	0.0185	0.0000	0.0171	0.1038	202.6038	202.5000	-0.10
200	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	202.5000	202.5000	0.00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(Joins sheet 28)
OXFORD ADD
SAN FRANCISCO
SAINT LOUIS
ST LOUIS
FRANCISCO
Beech Lake
water
Rawdon Landing Strip
6
5
4
7
8
9
18
17
16
Rd
Gb
Fb
Ia
Ic
Ta
Ce
Ec
Ma
Va
w
(Joins sheet 43)
2 365 000 FEET
(Joins sheet 44)
2 370 000 FEET

EXHIBIT NO. 1

SOIL LEGEND

SYMBOL	HYDROLOGIC GROUP	NAME
Aa	B	Albion-Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loans, 7 to 15 percent slopes
Ba	C	Blanket silt loam, 0 to 1 percent slopes
Bb	C	Blanket silt loan, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loan
Cb	B	Canadian-Waldeck fine sandy loams
Cc	D	Carwile fine sandy loam
Cd	B	Clark-Ost clay loams, 1 to 4 percent slopes
Ce	C	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 lopes
Wa	C	Waldeck sandy loam
Wb	D	Waurika silt loam

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

RECOMMENDED RUNOFF COEFFICIENTS FOR RATIONAL METHOD AND PERCENT IMPERVIOUS FOR UNIT HYDROGRAPH METHOD

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
1. Business:					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
2. Residential:					
Single Family (Soil Group D)					
1/8 Acre	50	0.57	0.61	0.66	0.79
1/4 Acre	38	0.50	0.54	0.62	0.76
1/3 Acre	30	0.46	0.50	0.59	0.73
1/2 Acre	25	0.42	0.48	0.56	0.72
3/4 Acre	22	0.42	0.46	0.55	0.71
1 Acre	20	0.41	0.45	0.54	0.71
Multi-Family (Soil Group D)					
Multi-Unit (detached)	60	0.62	0.66	0.72	0.82
Multi-Unit (attached)	65	0.64	0.68	0.73	0.83
Apartments	75	0.70	0.73	0.79	0.86
Single Family (Soil Group C)					
1/8 Acre	50	0.55	0.58	0.64	0.73
1/4 Acre	38	0.48	0.51	0.57	0.68
1/3 Acre	30	0.43	0.46	0.53	0.65
1/2 Acre	25	0.40	0.43	0.50	0.63
3/4 Acre	22	0.39	0.42	0.49	0.62
1 Acre	20	0.37	0.40	0.48	0.61
Multi-Family (Soil Group C)					
Multi-Unit (detached)	60	0.60	0.63	0.69	0.77
Multi-Unit (attached)	65	0.63	0.66	0.71	0.79
Apartments	75	0.68	0.72	0.77	0.83
Single-Family (Soil Group B)					
1/8 Acre	50	0.52	0.54	0.59	0.67
1/4 Acre	38	0.44	0.46	0.52	0.61
1/3 Acre	30	0.39	0.41	0.47	0.57
1/2 Acre	25	0.36	0.38	0.44	0.54
3/4 Acre	22	0.34	0.36	0.42	0.52
1 Acre	20	0.33	0.35	0.40	0.51
Multi-Family (Soil Group B)					
Multi-Unit (detached)	60	0.58	0.60	0.65	0.72
Multi-Unit (attached)	65	0.61	0.64	0.68	0.75
Apartments	75	0.67	0.70	0.74	0.80

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Single Family (Soil Group A)					
1/8 Acre	50	0.47	0.50	0.54	0.60
1/4 Acre	38	0.39	0.41	0.45	0.52
1/3 Acre	30	0.33	0.35	0.39	0.47
1/2 Acre	25	0.30	0.31	0.35	0.44
3/4 Acre	22	0.28	0.29	0.33	0.42
1 Acre	20	0.26	0.28	0.32	0.40
Multi-Family (Soil Group A)					
Multi-Unit (detached)	60	0.55	0.57	0.61	0.67
Multi-Unit (attached)	65	0.58	0.60	0.64	0.70
Apartments	75	0.65	0.68	0.72	0.77
3. Industrial:					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
4. Playgrounds:	15	0.33	0.35	0.42	0.55
5. Schools:	40	0.49	0.51	0.56	0.66
6. Railroad Yard Areas:	30	0.43	0.45	0.50	0.62
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):					
Soil Group A					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
Soil Group B					
Slope less than 1%	00	0.16	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
Soil Group C					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%	00	0.28	0.31	0.39	0.55

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Soil Group D					
Slope less than 1%	00	0.28	0.33	0.43	0.63
Slope 1% to 4%	00	0.30	0.35	0.45	0.65
Slope more than 4%	00	0.32	0.37	0.47	0.67

Note No. 1: Coefficients shown in the above table are for pervious open space areas with thick turf which includes pervious areas in parks and cemeteries. Coefficients shown above must be increased 0.02 for use with agricultural pasture areas. Coefficients shown above must be reduced by 0.04 for use with agricultural cultivated areas. Group A soils are well-drained, coarse textured sands with high infiltration rates. Group B soils are moderately well-drained, moderately coarse textured soils with moderate infiltration rates. Group C soils are moderately poor-drained, moderately fine textured soils with slow infiltration rates. Group D soils are poor-drained, fine textured soils with very slow infiltration rates.

GENERAL NOTE: These Rational Formula Coefficients may not be valid for basins 320 acres or larger.

April 15, 1986

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

CITY OF WICHITA, KANSAS

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40 Modified to NWS Hydro-35, 1977 During First Hour

DURATION IN MINUTES	RETURN PERIODS OF						
	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
11	3.27	4.36	5.16	5.89	6.81	7.61	8.27
12	3.18	4.21	4.99	5.71	6.60	7.38	8.02
13	3.05	4.08	4.84	5.53	6.41	7.17	7.79
14	2.96	3.95	4.69	5.37	6.23	6.97	7.57
15	2.87	3.83	4.56	5.22	6.06	6.78	7.37
16	2.78	3.72	4.43	5.08	5.90	6.60	7.18
17	2.71	3.61	4.31	4.95	5.75	6.44	7.00
18	2.63	3.51	4.20	4.83	5.61	6.29	6.84
19	2.56	3.42	4.10	4.71	5.47	6.14	6.68
20	2.50	3.33	4.00	4.60	5.35	6.00	6.53
21	2.44	3.25	3.90	4.50	5.23	5.87	6.39
22	2.38	3.17	3.81	4.40	5.12	5.75	6.26
23	2.32	3.10	3.73	4.31	5.01	5.63	6.13
24	2.27	3.03	3.65	4.22	4.91	5.52	6.01
25	2.22	2.96	3.57	4.13	4.81	5.41	5.90
26	2.20	2.90	3.50	4.05	4.72	5.31	5.79
27	2.16	2.84	3.43	3.98	4.63	5.21	5.69
28	2.14	2.78	3.37	3.90	4.55	5.12	5.59
29	2.11	2.72	3.30	3.83	4.47	5.03	5.49
30	2.08	2.67	3.24	3.76	4.39	4.94	5.40
31	2.05	2.62	3.19	3.70	4.32	4.86	5.32
32	2.02	2.57	3.10	3.63	4.25	4.79	5.22
33	1.99	2.52	3.05	3.57	4.18	4.71	5.14
34	1.96	2.48	3.01	3.51	4.11	4.63	5.07
35	1.93	2.44	2.98	3.46	4.05	4.56	5.00
36	1.91	2.39	2.93	3.41	3.99	4.50	4.93
37	1.89	2.35	2.88	3.36	3.93	4.43	4.86
38	1.87	2.32	2.84	3.31	3.87	4.37	4.79
39	1.85	2.28	2.80	3.26	3.82	4.31	4.73
40	1.83	2.24	2.76	3.22	3.76	4.25	4.66
41	1.81	2.21	2.72	3.17	3.71	4.19	4.60
42	1.79	2.18	2.68	3.13	3.66	4.13	4.54
43	1.77	2.14	2.64	3.09	3.61	4.08	4.49
44	1.75	2.11	2.61	3.05	3.57	4.03	4.43
45	1.73	2.08	2.57	3.01	3.52	3.98	4.38

ATTACHMENT A CONTINUED
Page 2

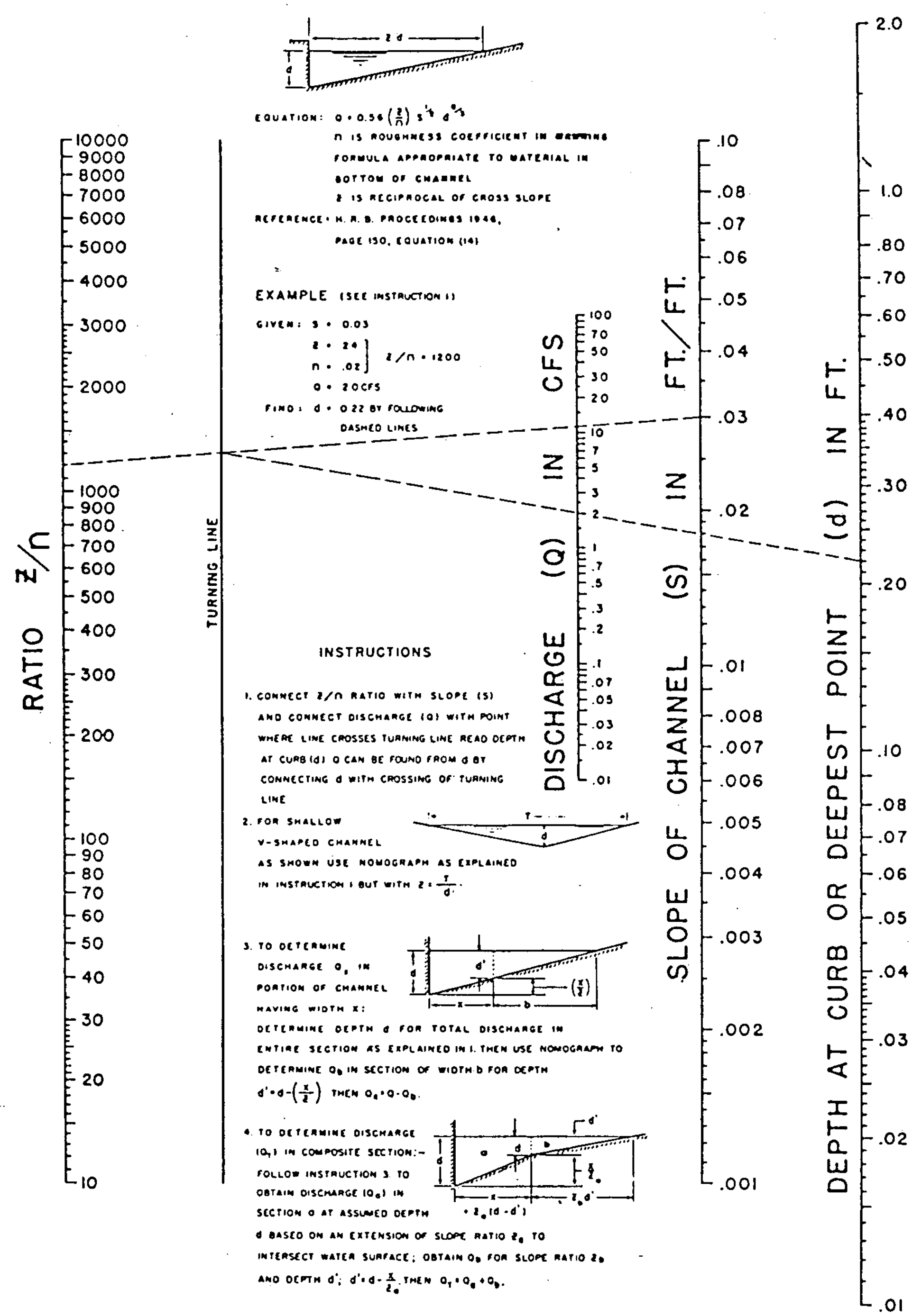
DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
46	1.70	2.05	2.54	2.97	3.48	3.93	4.33
47	1.67	2.02	2.50	2.93	3.44	3.88	4.28
48	1.66	2.00	2.47	2.90	3.39	3.84	4.23
49	1.64	1.97	2.44	2.86	3.35	3.79	4.18
50	1.61	1.95	2.41	2.83	3.32	3.75	4.13
51	1.59	1.92	2.38	2.79	3.28	3.71	4.09
52	1.56	1.89	2.35	2.76	3.24	3.67	4.05
53	1.54	1.86	2.33	2.73	3.20	3.63	4.00
54	1.52	1.84	2.30	2.70	3.17	3.59	3.96
55	1.50	1.81	2.27	2.67	3.14	3.55	3.92
56	1.47	1.79	2.25	2.64	3.10	3.51	3.88
57	1.45	1.76	2.22	2.61	3.07	3.48	3.84
58	1.43	1.74	2.20	2.59	3.04	3.44	3.81
59	1.42	1.72	2.18	2.56	3.01	3.41	3.77
60	1.40	1.69	2.15	2.53	2.98	3.37	3.73
61	1.38	1.67	2.13	2.51	2.95	3.34	3.70
62	1.36	1.65	2.11	2.48	2.92	3.31	3.67
63	1.34	1.63	2.09	2.46	2.89	3.28	3.63
64	1.33	1.61	2.07	2.44	2.86	3.25	3.60
65	1.31	1.59	2.05	2.41	2.84	3.22	3.57
66	1.30	1.57	2.03	2.39	2.81	3.19	3.54
67	1.28	1.56	2.01	2.37	2.79	3.16	3.51
68	1.26	1.54	1.99	2.35	2.76	3.13	3.48
69	1.25	1.52	1.97	2.33	2.74	3.10	3.45
70	1.24	1.50	1.95	2.31	2.71	3.08	3.42
71	1.22	1.49	1.93	2.28	2.69	3.05	3.39
72	1.21	1.47	1.92	2.26	2.67	3.02	3.36
73	1.20	1.46	1.90	2.25	2.64	3.00	3.34
74	1.18	1.44	1.88	2.23	2.63	2.98	3.31
75	1.17	1.43	1.86	2.21	2.61	2.95	3.29
76	1.16	1.41	1.85	2.19	2.58	2.93	3.26
77	1.15	1.40	1.83	2.17	2.55	2.90	3.24
78	1.13	1.38	1.82	2.15	2.53	2.88	3.22
79	1.12	1.37	1.80	2.14	2.50	2.86	3.19
80	1.11	1.36	1.79	2.12	2.48	2.84	3.16
81	1.10	1.34	1.77	2.10	2.46	2.82	3.13
82	1.09	1.33	1.76	2.08	2.43	2.79	3.10
83	1.08	1.32	1.74	2.06	2.41	2.76	3.07
84	1.07	1.31	1.73	2.04	2.39	2.74	3.04
85	1.06	1.30	1.72	2.02	2.37	2.71	3.01
86	1.05	1.28	1.70	2.00	2.34	2.69	2.99
87	1.04	1.27	1.69	1.99	2.32	2.66	2.96
88	1.03	1.26	1.68	1.97	2.30	2.64	2.93
89	1.02	1.25	1.68	1.95	2.28	2.62	2.91
90	1.01	1.24	1.66	1.93	2.26	2.59	2.88

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
91	1.00	1.23	1.65	1.92	2.24	2.57	2.86
92	1.00	1.22	1.63	1.90	2.22	2.55	2.83
93	0.99	1.21	1.62	1.89	2.20	2.53	2.81
94	0.98	1.20	1.61	1.87	2.19	2.51	2.79
95	0.97	1.19	1.59	1.85	2.17	2.49	2.76
96	0.96	1.18	1.58	1.84	2.15	2.46	2.74
97	0.96	1.17	1.57	1.82	2.13	2.44	2.72
98	0.95	1.16	1.56	1.81	2.12	2.42	2.70
99	0.94	1.15	1.54	1.80	2.10	2.41	2.67
100	0.93	1.14	1.53	1.78	2.08	2.39	2.65
101	0.93	1.13	1.52	1.77	2.07	2.39	2.65
102	0.92	1.13	1.51	1.75	2.05	2.35	2.61
103	0.91	1.12	1.50	1.74	2.04	2.33	2.59
104	0.90	1.11	1.49	1.73	2.02	2.31	2.57
105	0.90	1.10	1.47	1.72	2.01	2.30	2.55
106	0.89	1.09	1.46	1.70	1.99	2.28	2.54
107	0.88	1.09	1.45	1.69	1.98	2.26	2.52
108	0.88	1.08	1.44	1.68	1.96	2.25	2.50
109	0.87	1.07	1.43	1.67	1.95	2.23	2.48
110	0.87	1.06	1.42	1.65	1.93	2.21	2.46
111	0.86	1.06	1.41	1.64	1.92	2.20	2.45
112	0.85	1.05	1.40	1.63	1.91	2.18	2.43
113	0.85	1.04	1.39	1.62	1.89	2.17	2.41
114	0.84	1.03	1.38	1.61	1.88	2.15	2.40
115	0.84	1.03	1.37	1.60	1.87	2.14	2.38
116	0.83	1.02	1.36	1.59	1.86	2.12	2.36
117	0.82	1.01	1.36	1.58	1.84	2.11	2.35
118	0.82	1.01	1.35	1.57	1.83	2.09	2.33
119	0.81	1.00	1.34	1.56	1.82	2.08	2.32
120	0.81	0.99	1.33	1.55	1.81	2.07	2.30

DURATION IN HOURS	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
2	0.81	0.99	1.33	1.55	1.81	2.07	2.30
3	0.59	0.72	0.97	1.13	1.32	1.51	1.68
4	0.47	0.58	0.78	0.91	1.06	1.21	1.35
5	0.40	0.49	0.66	0.77	0.89	1.02	1.14
6	0.35	0.42	0.57	0.67	0.78	0.89	0.99
8	0.28	0.34	0.46	0.53	0.62	0.71	0.79
10	0.23	0.29	0.39	0.45	0.52	0.60	0.67
12	0.20	0.25	0.33	0.39	0.45	0.52	0.58
18	0.15	0.18	0.24	0.28	0.33	0.38	0.42
24	0.12	0.15	0.20	0.23	0.27	0.31	0.34

0014S

Chart 1



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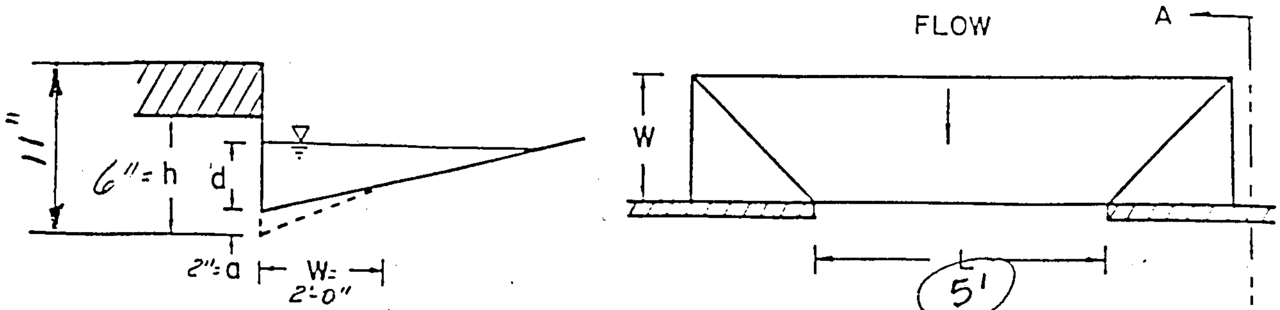
NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS



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

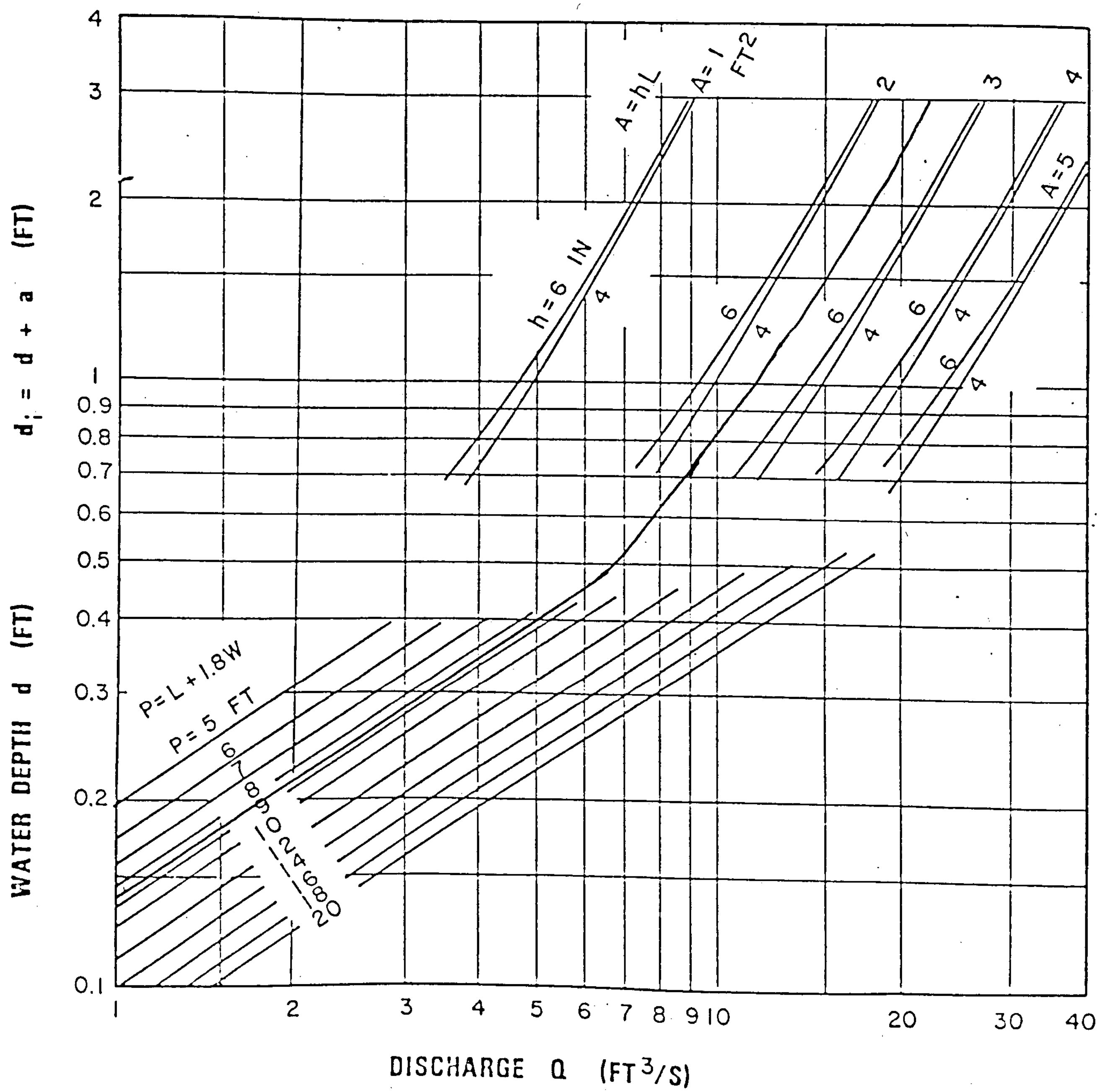
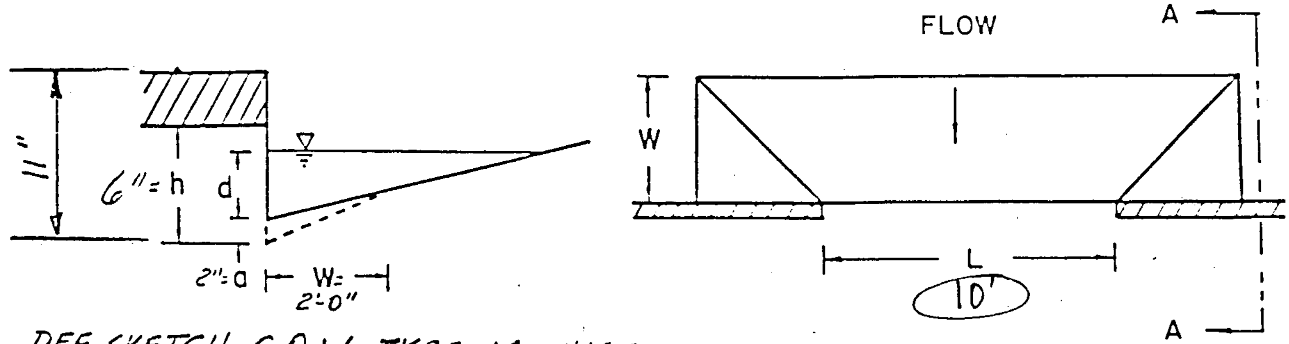


CHART 12. Depressed curb-opening inlet capacity in sump locations.

From: HEC-12, Drainage of Highway Pavements, F.H.W.A., Mar., 1984



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

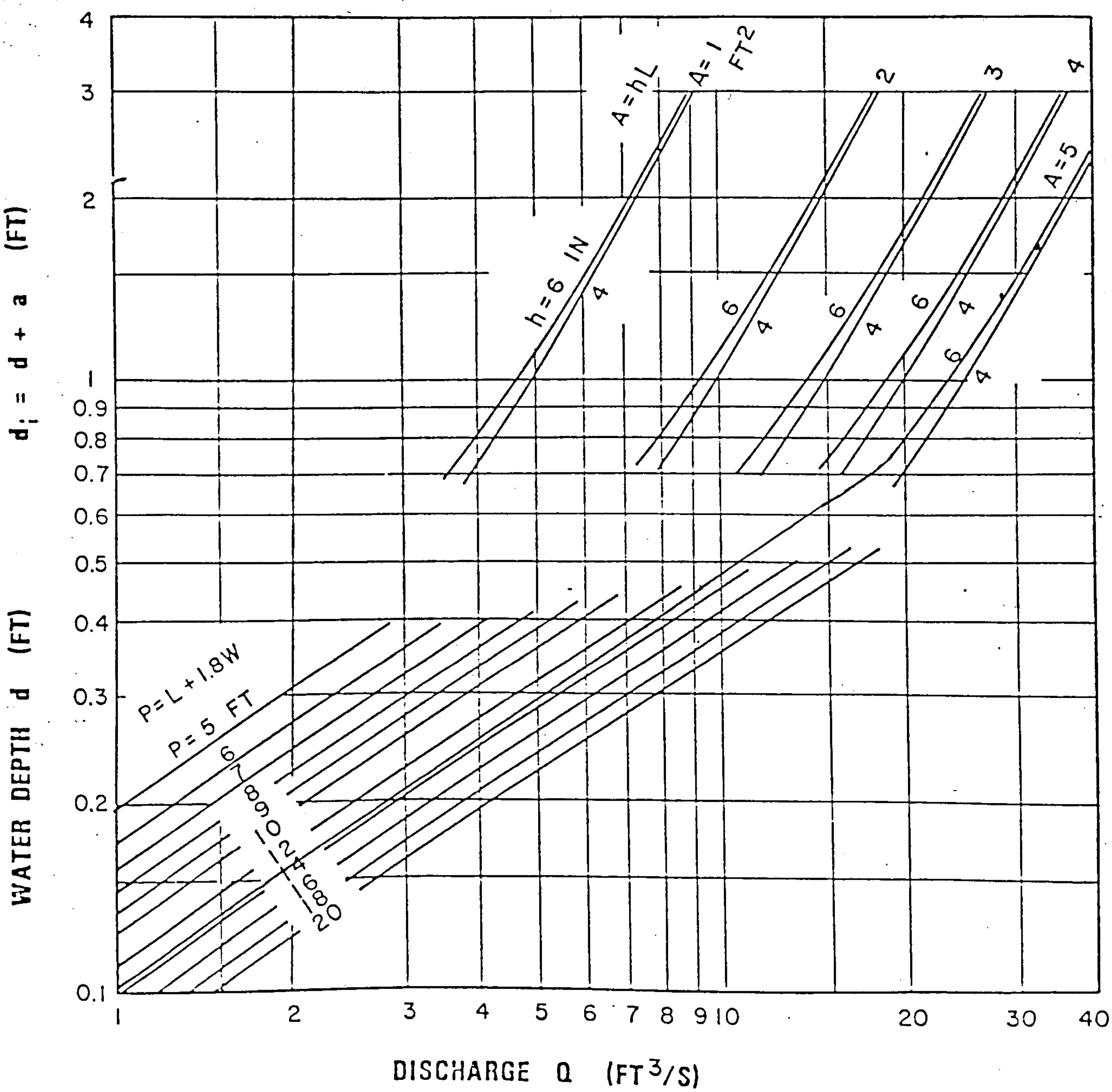


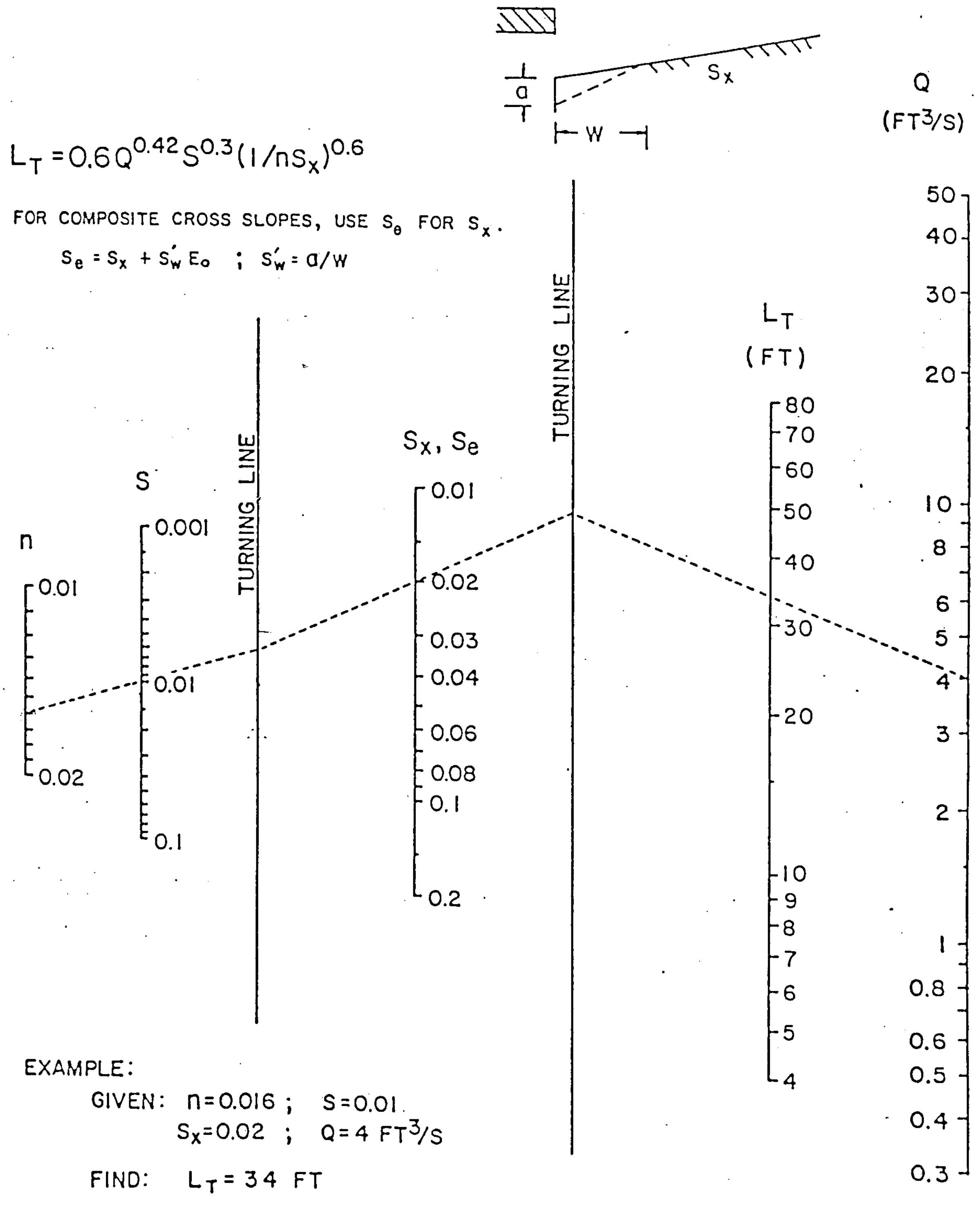
CHART 12. Depressed curb-opening inlet capacity in sump locations.

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

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

FOR COMPOSITE CROSS SLOPES, USE S_e FOR S_x.

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



EXAMPLE:

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

FIND: L_T = 34 FT

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

From: HEC-12, Drainage of Highway Pavements, F.H.W.A., Mar. 1984.

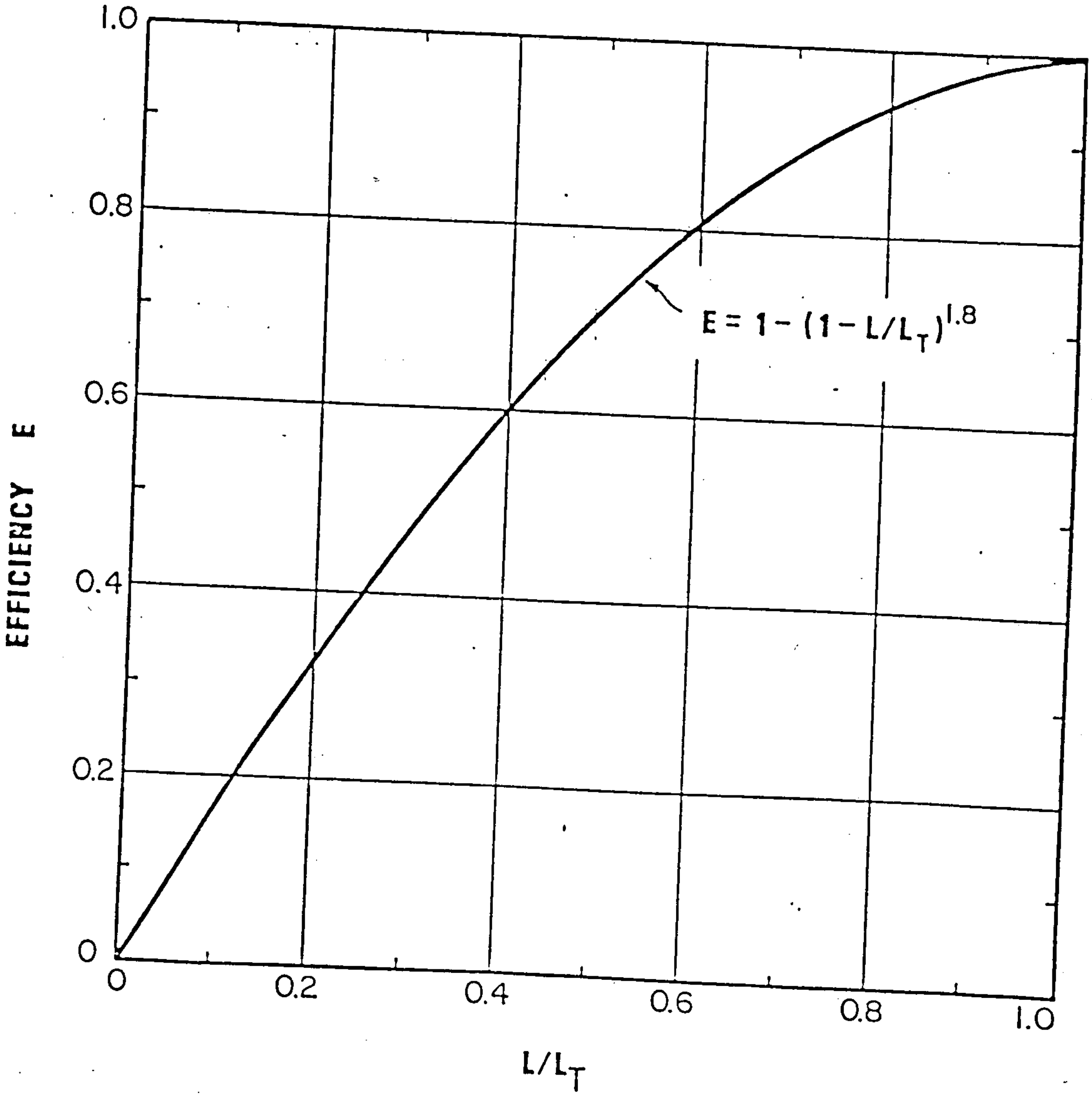


CHART 10. Curb–opening and slotted drain inlet interception efficiency.

From: HEC-12, Drainage of Highway Pavements, F.H.W.A., Mar. 1984

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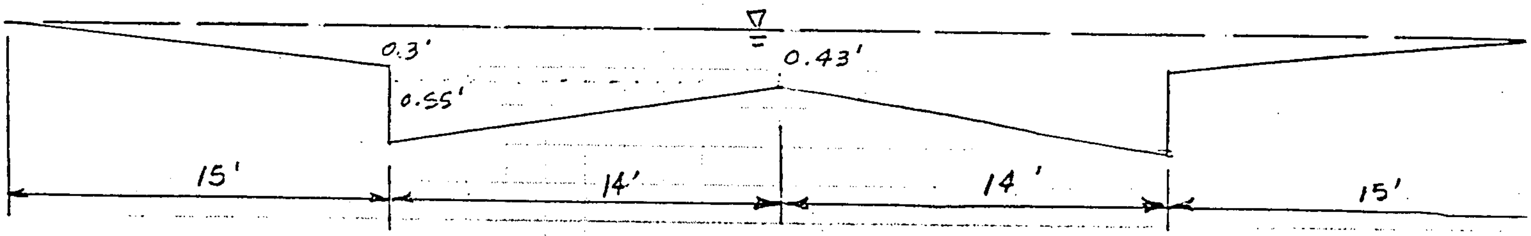
Item ______

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

0.3' WALK GRADE



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

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

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

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

$$= 22.42$$

$p = 59.1$

$R = A/p = 22.42/59.1 = 0.379357$ $\quad R^{2/3} = 0.52404$

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

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

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

0.4' WALK GRADE

$n = 0.0226$

$A = (2 \times 1/2 \times 15 \times 0.4) + (28 \times 0.53) + (2 \times 1/2 \times 14 \times 0.42)$

$= (6.00) + (14.84) + (5.88)$

$= 26.72$

$p = 59.1$

$R = A/p = 26.72/59.1 = 0.452115 \qquad R^{2/3} = 0.589069$

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

$$Q = \frac{1.486}{0.0226} \times 26.72 \times 0.589069 \times S^{1/2}$$

$$Q = 1,034.93 \sqrt{S}$$

0.5' WALK GRADE

$n = 0.0226$

$A = (2 \times 1/2 \times 15 \times 0.5) + (28 \times 0.63) + (2 \times 1/2 \times 14 \times 0.42)$

$= (7.5) + (17.64) + (5.88)$

$= 31.02$ SF

$p = 59.1$

$R = A/p = 31.02/59.1 = 0.524873 \quad R^{2/3} = 0.650683$

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

$Q = \frac{1.486}{0.0226} \times 31.02 \times 0.650683 \times s^{1/2}$

$Q = 1{,}327.15 \sqrt{s}$

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1440 EAST ENGLISH
WICHITA, KANSAS
ZIP CODE / 67211

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0.6' WALK GRADE

$n = 0.0226$

$A = (2 \times 1/2 \times 15 \times 0.6) + (28 \times 0.73) + (2 \times 1/2 \times 14 \times 0.42)$

$= (9.0) + (20.44) + (5.88)$

$= 35.32$

$p = 59.1$

$R = A/p = 35.32/59.1 = 0.597631 \quad R^{2/3} = 0.709505$

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

$Q = \frac{1.486}{0.0226} \times 35.32 \times 0.709505 \times s^{1/2}$

$Q = 1{,}647.73 \sqrt{s}$

0.7' WALK GRADE

$n = 0.0226$

$A = (2 \times 1/2 \times 15 \times 0.7) + (28 \times 0.83) + (2 \times 1/2 \times 14 \times 0.42)$

$= (10.5) + (23.24) + (5.88)$

$= 39.62$

$p = 59.1$

$R = A/p = 39.62/59.1 = 0.670389$ $R^{2/3} = 0.765981$

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

$Q = \frac{1.486}{0.0226} \times 39.62 \times 0.765981 \times s^{1/2}$

$Q = 1{,}995.46 \sqrt{S}$

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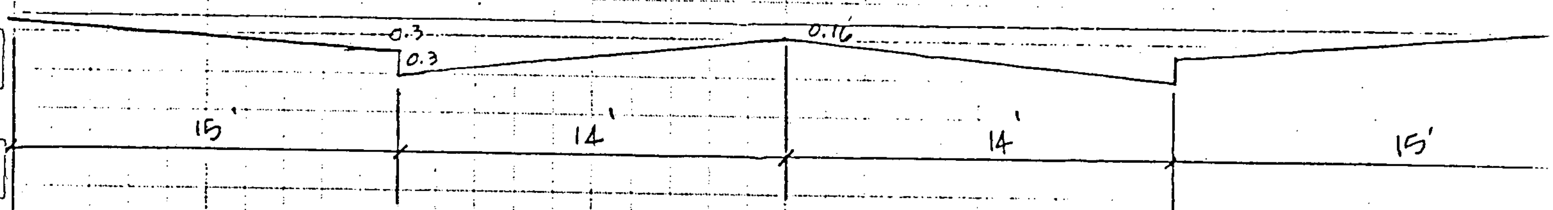
Determine capacities of Roll-curb streets w/ Various Walk Grades for 100-year storm analysis (58' R-O-W)

0.3'
Walk Grade



$$n = \frac{(2 \times 14.5 \times 0.03) + (2 \times 2.8 \times 0.013) + (2 \times 12 \times 0.016)}{58.6}$$

$$= \frac{(0.87) + (0.0728) + (0.384)}{58.6} = \frac{1.3268}{58.6} = 0.0226$$

$$A = (2 \times 1/2 \times 15 \times 0.3) + (28 \times 0.16) + (2 \times 1/2 \times 14 \times 0.44)$$

$$= 4.5 + 4.48 + 6.16$$

$$= 15.14 \text{ SF}$$

$$P = 58.6$$

$$R = A/P = 15.14/58.6 = 0.258362 \qquad R^{2/3} = 0.40565$$

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

$$= \frac{1.486}{0.0226} \times 15.14 \times 0.40565 \times S^{1/2}$$

$$Q = 403.82 \sqrt{S}$$

0.4 Walk Grade

$n = 0.0226$

$A = (2 \times 1/2 \times 15 \times 0.4) + (28 \times 0.26) + (2 \times 1/2 \times 14 \times 0.44)$

$= 6.0 + 7.28 + 6.16$

$= 19.44$

$p = 58.6$

$R = A/p = 19.44/58.6 = 0.33174 \qquad R^{2/3} = 0.479217$

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2} = \frac{1.486}{0.0226} \times 19.44 \times 0.479217 \times S^{1/2}$

$Q = 612.55 \sqrt{S}$

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Project ______

Item ______

...ESSIONAL ...NEERING ...ULTANTS ...NAL ASSOCIATION
...40 EAST ENGLISH
WICHITA, KANSAS
ZIP CODE / 67211

0.5 Walk Grade

$n = 0.0226$

$A = (2 \times 1/2 \times 15 \times 0.5) + (28 \times 0.36) + (2 \times 1/2 \times 14 \times 0.44)$

$= 7.5 + 10.08 + 6.16$

$= 23.74$

$p = 58.6$

$R = A/p = 23.74/58.6 = 0.405119 \quad R^{2/3} = 0.547506$

$Q = \frac{1.486}{0.0226} \times 23.74 \times 0.547506 \times s^{1/2}$

$= 854.63 \sqrt{s}$

Date ____________ Page ______ of ______

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0.6 Walk Grade

$n = 0.0226$

$A = (2 \times 1/2 \times 15 \times 0.6) + (28 \times 0.46) + (2 \times 1/2 \times 14 \times 0.44)$

$= 9.0 + 12.88 + 6.16$

$= 28.04$

$p = 58.6$

$R = A/p = 28.04/58.6 = 0.478498 \quad R^{2/3} = 0.611768$

$$Q = \frac{1.486}{0.0226} \times 28.04 \times 0.611768 \times s^{1/2}$$

$= 1,127.91 \sqrt{s}$

...ESSIONAL
...NEERING
...ULTANTS
...NAL ASSOCIATION
...40 EAST ENGLISH
WICHITA, KANSAS
ZIP CODE / 67211

Date ______ Page ______ of ______

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0.7 Walk Grade

$n = 0.0226$

$A = (2 \times 1/2 \times 15 \times 0.7) + (28 \times 0.56) + (2 \times 1/2 \times 14 \times 0.44)$

$= 10.5 + 15.68 + 6.16$

$= 32.34$

$p = 58.6$

$R = A/p = 32.34/58.6 = 0.551877 \qquad R^{2/3} = 0.672814$

$Q = \frac{1.486}{0.0226} \times 32.34 \times 0.672814 \times s^{1/2}$

$Q = 1,430.69 \sqrt{s}$

RATH_G

From: HENRY_L
Sent: Wednesday, June 23, 1999 3:12 PM
To: RATH_G; LINDEBAK_M
Cc: LACKEY_S
Subject: Hardtner Box Culvert - west of 119th

Sensitivity: Private

I went out on a call that we had a wash out / collapse behind the wing wall on the north side of this box culvert. There is a sizeable wash out that we need to repair. I noted that the weep hole on one of the wing walls was gushing like a fire hose.

I am curious what is making this weephole gush like this, and wondering if we have a cavern connecting it to the water source, which might collapse. Can you pull a plan of this box and let me see how it was designed?

MID-KANSAS ENGINEERING CONSULTANTS, INC.
411 North Webb Road
Wichita, Kansas 67206
316-684-9600 FAX 316-684-5100

LETTER OF TRANSMITTAL

PROJECT:

PROJECT NO:

DATE: August 30, 1999

TO: Vicky Huang, P.E.
City of Wichita Engineering
455 N. Main - 7th Floor
Wichita, KS 67202

We are sending you the following items: __X__ Attached
_____ Under separate cover
_____ Via__________

_____ Drawings
_____ Specifications
_____ Computer Disk(s)
_____ Maps
_____ Petitions
__X__ Other

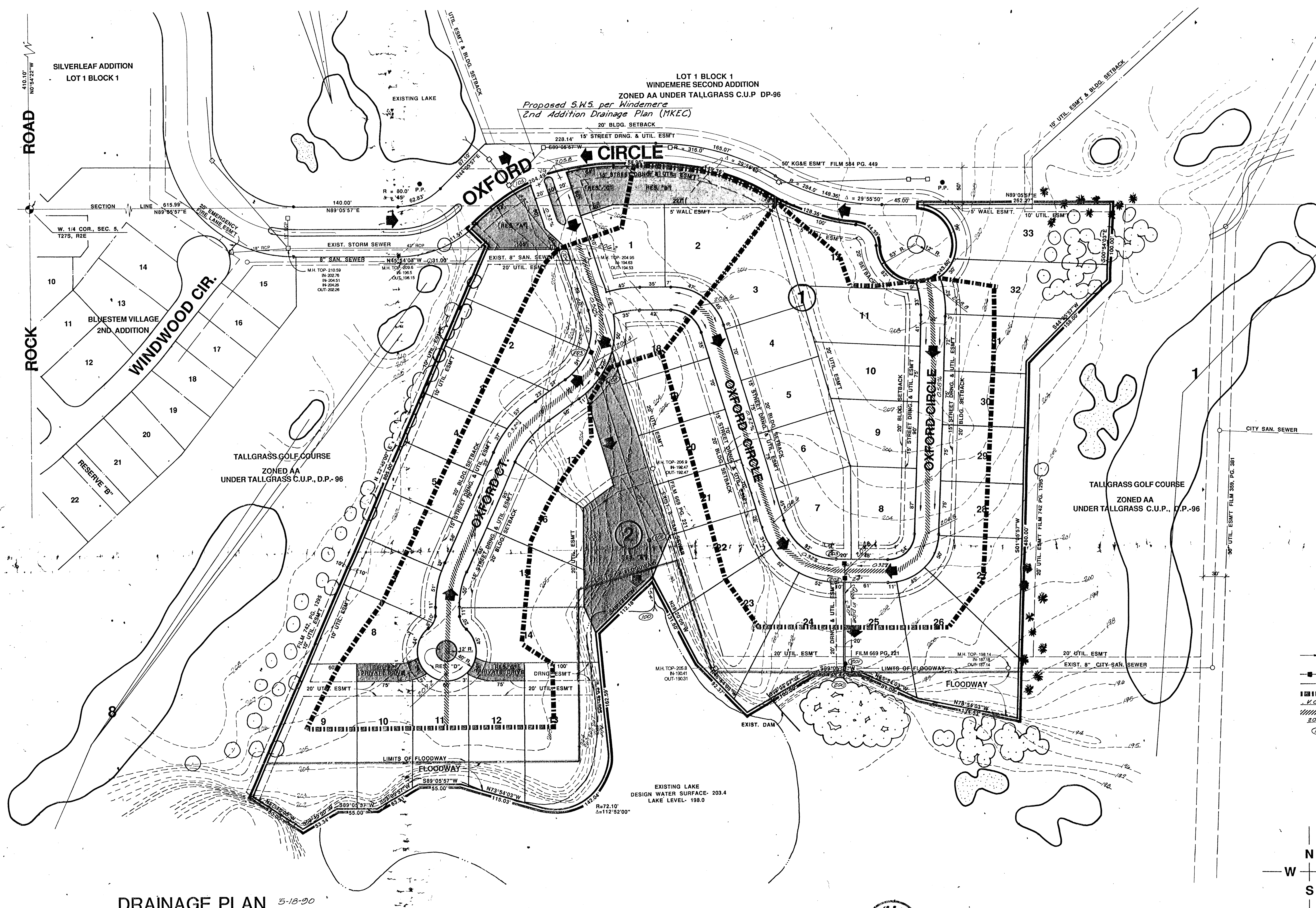
COMMENTS: Returning your copy of PEC's Drainage Plan for Oxford Addition, Sedgwick County, Kansas.

_____ For Your Approval
__X__ As Requested
_____ For Your Use
_____ For Your Files
_____ Approved As Noted
_____ For Review and Comment

REMARKS:

Signed: Kenneth Bengtson /ny
Kenneth H. Bengtson, President

K:\WP\TRANSMIT.WPD



NOTES

1.) TOPOGRAPHY PREPARED BY M.K.E.C.

2.) DRAINAGE CONCEPT PLAN TO BE SUBMITTED TO CITY ENGINEER BY M.K.E.C.

3.) SETBACKS ARE AS PER GENERAL PROVISION NO. 4 OF TALLGRASS C.U.P., D.P.- 96.

4.) RESERVES "A" & "B" ARE FOR DRAINAGE LANDSCAPING, IRRIGATION, ENTRY MONUMENTS, WALLS AND UTILITIES CONFINED TO ESM'TS.

5.) BENCH MARK: SCORE MARK AT BASE OF "Y" POLE 30' N. & 60' E. OF 1/4 SEC. CORNER- ELEV. 218.63.

6.) AREA WITHIN FLOODWAY TO PERMIT ACCESS TO AND MAINTENANCE OF SHORE LINE OF LAKE.

7. ALL RESERVES ARE TO BE OWNED AND MAINTAINED BY A HOMEOWNERS ASSOCIATION.

8. RESERVES "F" & "G" ARE FOR DRNG., ACCESS, PRIVATE DRIVES, AND UTILITIES.

9. RESERVES "C" & "D" ARE FOR LANDSCAPING, SIGNS, AND IRRIGATION.

10. RESERVE "E" IS FOR DRAINAGE, DRAINAGE STRUCTURES, LANDSCAPING, WALKS, GAZEBOES AND UTILITIES CONFINED TO ESM'TS.

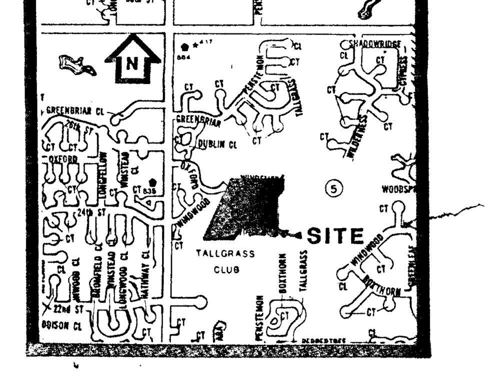
11. THE 20' DRAINAGE ESM'TS. FILM 810, PG. 86 AND FILM 942, PG. 392 TO BE VACATED BY VIRTUE OF FINAL PLAT.

MINIMUM PAD ELEVATIONS

LOTS 9-15, 22 & 23 BLOCK 2 = 205.0
LOT 24 BLOCK 2 = 204.0
LOT 25 BLOCK 2 = 203.0
LOT 26 BLOCK 2 = 202.0

LEGEND

- Drainage Direction-Minor Storm
- Drainage Direction-Major Storm
- Proposed Storm Water Sewer & Inlet
- Proposed Storm Water Sewer & Manhole
- Proposed Drainage Basin
- V.G. Proposed Valley Gutter
- Proposed Drainage Sub-basin
- 203.8 × Proposed Street Elevation
- (100) Node Identification Point



LOCATION MAP
NO SCALE

DRAINAGE PLAN 5-18-90

OXFORD ADDITION

CHARLES S. BROWN LICENSED 7581 KANSAS PROFESSIONAL ENGINEER

TOTAL ACRES : 14.2
TOTAL AREA : 620,373 S.F.

SCALE: 1" = 50'

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

OWNER : SLAWSON INVESTMENTS CORPORATION 104 S. BROADWAY, WICHITA, KS. 67202 PH.- (316) 263-3201

DATE: MARCH 22, 1990 APRIL 3, 1990

100' 50' 25' 0 25' 50' 100' 200'

BILL G. YUNG DESIGN
4912 E. 29TH STREET NORTH WICHITA, KS 67220 316-683-5567

(208)