MOEHRING & ASSOCIATES ——— CONSULTING ENGINEERS

SISTERS OF ST. JOSEPH 4TH ADDITION
WICHITA, KANSAS

DRAINAGE STUDY

MOEHRING & ASSOCIATES
CONSULTING ENGINEERS
WICHITA
AUGUST 1993

433 S. HYDRAULIC ——— WICHITA, KANSAS 67211 ——— 263-8291

SISTERS OF ST. JOSEPH 4TH ADDITION
DRAINAGE EVALUATION

The site being evaluated is North of Bayley Street and East of Clifton Ave., a portion of which was previously platted as Sisters of St.Joseph 3rd Addition and is presently occupied by an institutional office building and associated off street parking.

The preponderance of surface water drainage from these present improvements is directed to the South and discharges through drive approaches into Bayley Street.

Being near the top of a hill there are no storm water sewers in Bayley St., and the discharge from this property and from other areas South of Bayley St., are carried West in the street pavement toward the intersection of Clifton and Bayley

The drainage pattern of the paved drive and parking areas on the East and South side of the existing building cannot be readily altered, however the intent of the plan proposed by this study is to reduce the rate of runoff from the total area by creating a detention basin to control the discharge from the roofs of both the existing and the future buildings.

The enclosed print of the drainage plan shows the proposed detention basin and also the outline of the drainage area contributing to the basin. The drainage area contributing to the basin is 0.98 Ac.; the impervious area, representing the roofs of both buildings = 0.53 Ac.; and the balance of the total area contributing to the basin = 0.45 Ac., to be evaluated as lawns in hydrologic soil group "B".

Enclosed are the computations used to compute the runoff from the contributing drainage area, identified as Pre-Developed Conditions (without buildings) and Post-Developed Conditions (with buildings).

The publication "Interim Drainage and Storm Sewer Policy for Design and Documentation, City of Wichita" was used as a guide for the hydrologic and hydrologic computations. This publication is hereinafter referred to as the "Policy Manual".

The time of concentration (Tc), was evaluated as the sum of overland flow times and shallow concentrated flow time, and found to be less than 15 minutes, and therefore the 15 minute minimum has been used for determination of rainfall intensity.

The Rational Method was used for the hydrologic analysis. Runoff coefficients and rainfall intensities were based on tabular values provided in the "Policy Manual". The Hydrologic Soil Group was identified from the SCS Soils map for Sedgwick County.

The 100-year return period storm was used as the basis of evaluation of both the Pre and Post Developed runoff, and subsequent routing of the Post Developed runoff through the detention basin.

COMPUTATION PROCEDURE -

Enclosed are computer print outs, Pages C-1 thru C-12 inclusive, of the calculations for peak discharge (Q); Hydrograph values using the Q/Qp vs. T/Tp template derived from the SCS dimensionless unit hydrograph; pond volume determination from planimeter survey; input data for the outlet structure; computation of outlet structure rating table; combining outlet structure file with pond volume file, to produce the pond outflow rating table; pond routing computations, using Post-Developed inflow hydrograph and the pond outflow rating table, to produce the outflow hydrograph; the printed summary of pond routing computations followed by the graphical display of the inflow/outflow hydrograph relationship.

PAGE	PROCEDURE	RESULTS
C-1	Q, for Pre-Developed Conditions	2.96 cfs.
C-2	Pre-Developed Hydrograph Values	Table
C-3	Q, for Post-Developed Conditions	4.99 cfs.
C-4	Post-Developed Hydrograph Values	Table
C-5	Pond Volume File	Table
C-6	Outlet Structure, Input Data	Data
C-7	Outlet Structure, Rating Table	Table
C-8	Combining Pond Volume File & Outlet Structure Rating Table to create Pond Outflow Rating Table	---
C-9 & 10	Pond Routing Computations to produce Pond Outflow Hydrograph	Table(s)
C-11	Routing Summary - Peak Inflow	4.99 cfs.
	- Peak Outflow	2.08 cfs.
	- Peak Elevation	51.57 ft.
	- Peak Storage	0.07 Ac.ft.
C-12	Graph of Inflow/Outflow Hydrographs	---

SUMMARY -

If the drainage improvements as suggested in this study are implemented at the time of construction of the additional office building (which is reason for the platting procedure of Sisters of St.Joseph 4th Addition, and this study), the rate of discharge of storm water runoff from not only the future building but also the existing building can be reduced.

The discharge rate from the combined roof areas (@ 2.08 cfs) would then be approximately 70 % of the runoff from the same area left as lawns (2.96 cfs)

It would seem reasonable that the proposed drainage improvement would minimize any adverse effects resulting from the future addition of office space, and would also serve as an improvement to existing conditions.

Respectfully Submitted,

MOEHRING & ASSOCIATES
CONSULTING ENGINEERS

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 15:43:39 08-12-1993

SISTERS OF ST. JOSEPH 4TH ADDITION
100 YR FREQUENCY
PRE-DEVELOPED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
"B" LAWNS	0.410	0.98						
			15.00	0.410	0.410	7.370	0.98	2.96

Quick TR-55 Ver.5.43 S/N:1240540379
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SISTERS OF ST. JOSEPH 4TH ADDITION
100 YR FREQUENCY
PRE-DEVELOPED CONDITIONS

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.410 Area= 0.980 acres Tc = 15.00 minutes

Adjusted C = 0.410 Tc= 15.00 min. I= 7.37 in/hr Qp= 2.96 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: STJOEPRE.HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.083 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.000	0.00	0.68	2.27	2.96	2.47	1.46	0.83
0.583	0.49	0.29	0.16	0.10	0.06	0.03	0.02
1.167	0.01	0.00					

SISTERS OF ST. JOSEPH 4TH ADDITION
100 FREQUENCY
POST-DEVELOPED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
ROOFS	0.930	0.53						
"B" LAWNS	0.410	0.45						
			15.00	0.691	0.691	7.370	0.98	4.99

SISTERS OF ST. JOSEPH 4TH ADDITION
100 FREQUENCY
POST-DEVELOPED CONDITIONS

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.691 Area= 0.980 acres Tc = 15.00 minutes

Adjusted C = 0.691 Tc= 15.00 min. I= 7.37 in/hr Qp= 4.99 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: STJOE4 .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.083 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.000	0.00	1.15	3.83	4.99	4.16	2.46	1.40
0.583	0.83	0.48	0.27	0.16	0.09	0.05	0.03
1.167	0.02	0.00					

POND-2 Version: 5.14
S/N: 1220510530

SISTERS OF ST. JOSEPH 4TH ADDITION
100 YR FREQUENCY
POND AREA

CALCULATED 08-12-1993 15:34:27
DISK FILE: C:\PONDPACK\STJOE4 .VOL

Planimeter scale: 1 inch = 20 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	* Volume (acre-ft)	Volume Sum (acre-ft)
50.00	2.83	0.03	0.00	0.00	0.00
51.00	5.21	0.05	0.11	0.04	0.04
52.00	8.69	0.08	0.19	0.06	0.10

$$IA = (\text{sq.rt}(Area1) + ((Ei-E1)/(E2-E1))*(\text{sq.rt}(Area2)-\text{sq.rt}(Area1)))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* Incremental volume computed by the Conic Method for Reservoir Volumes.

$$Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + \text{sq.rt.}(Area1*Area2))$$

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Outlet Structure File: STJOE4 .STR

POND-2 Version: 5.14 S/N: 1220510530
Date Executed: Time Executed:

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SISTERS OF ST. JOSEPH 4TH ADDITION
1-8 " PVC OUTLET

****

>>>>>> Structure No. 1 <<<<<<
(Input Data)

CULVERT-CR
Circular Culvert (With Inlet Control)

E1 elev.(ft)?	50.0
E2 elev.(ft)?	52.0
Diam. (ft)?	0.67
Inv. el.(ft)?	50.0
Slope (ft/ft)?	0.016
T1 ratio?	
T2 ratio?	
K Coeff.?	.0045
M Coeff.?	2.0
c Coeff.?	0.0317
Y Coeff.?	.69
Form 1 or 2?	1
Slope factor?	-0.5

Outlet Structure File: STJOE4 .STR

POND-2 Version: 5.14 S/N: 1220510530
Date Executed: Time Executed:

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SISTERS OF ST. JOSEPH 4TH ADDITION
1-8 " PVC OUTLET

****

Outflow Rating Table for Structure #1
CULVERT-CR Circular Culvert (With Inlet Control)

***** INLET CONTROL ASSUMED *****

Elevation (ft)	Q (cfs)	Computation Messages
50.00	0.0	No headwater
50.25	0.2	Equ.1: HW =.25 dc=.182 Ac=.078
50.50	0.6	Equ.1: HW =.5 dc=.355 Ac=.19
50.75	1.1	Transition: HW =.750
51.00	1.5	Submerged: HW =1.0
51.25	1.8	Submerged: HW =1.25
51.50	2.0	Submerged: HW =1.5
51.75	2.3	Submerged: HW =1.75
52.00	0.0	E = or > E2=52.0

Used Unsubmerged Equ. Form (1) for elev. less than 50.73 ft
Used Submerged Equation for elevations greater than 50.8 ft
HW=Headwater (ft) dc=Critical depth (ft) Ac=Area (sq.ft) at dc

Transition flows interpolated from the following values:
E1=50.73 ft; Q1=1.01 cfs; Dc=.48 ft; E2=50.8 ft; Q2=1.15 cfs

Outlet Structure File: STJOE4 .STR

POND-2 Version: 5.14 S/N: 1220510530
Date Executed: Time Executed:

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SISTERS OF ST. JOSEPH 4TH ADDITION
1-8 " PVC OUTLET

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Outlet Structure File: C:\PONDPACK\STJOE4 .STR
Planimeter Input File: C:\PONDPACK\STJOE4 .VOL
Rating Table Output File: C:\PONDPACK\STJOE4 .PND

Min. Elev.(ft) = 50 Max. Elev.(ft) = 52 Incr.(ft) = .25

Additional elevations (ft) to be included in table:
* *

****
SYSTEM CONNECTIVITY
****

Structure	No.	Q Table		Q Table
CULVERT-CR	1		->	1

Outflow rating table summary was stored in file:
C:\PONDPACK\STJOE4 .PND

POND-2 Version: 5.14 S/N: 1220510530
EXECUTED: 08-12-1993 15:50:04

****
* SISTERS OF ST. JOSEPH 4TH ADDITION *
* 1-8 " PVC OUTLET *
****

Inflow Hydrograph: C:\PONDPACK\STJOE4 .HYD
Rating Table file: C:\PONDPACK\STJOE4 .PND

-----INITIAL CONDITIONS-----
Elevation = 50.00 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
50.00	0.0	0.000	0.0	0.0
50.25	0.2	0.007	2.1	2.3
50.50	0.6	0.015	4.5	5.1
50.75	1.1	0.025	7.3	8.4
51.00	1.5	0.036	10.6	12.1
51.25	1.8	0.049	14.3	16.1
51.50	2.0	0.064	18.6	20.6
51.75	2.3	0.081	23.4	25.7

Time increment (t) = 0.083 hrs.

POND-2 Version: 5.14 S/N: 1220510530
EXECUTED: 08-12-1993 15:50:04

Pond File: C:\PONDPACK\STJOE4 .PND
Inflow Hydrograph: C:\PONDPACK\STJOE4 .HYD
Outflow Hydrograph: C:\PONDPACK\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
0.000	0.00	------	0.0	0.0	0.00	50.00
0.083	1.15	1.2	0.9	1.2	0.10	50.13
0.167	3.83	5.0	4.5	5.9	0.73	50.56
0.250	4.99	8.8	10.1	13.3	1.59	51.08
0.333	4.16	9.2	15.4	19.3	1.94	51.43
0.417	2.46	6.6	17.8	22.0	2.08	51.57
0.500	1.40	3.9	17.6	21.7	2.07	51.55
0.583	0.83	2.2	15.9	19.8	1.97	51.46
0.667	0.48	1.3	13.5	17.2	1.85	51.31
0.750	0.27	0.8	10.9	14.2	1.66	51.13
0.833	0.16	0.4	8.5	11.3	1.42	50.95
0.917	0.09	0.3	6.5	8.7	1.14	50.77
1.000	0.05	0.1	5.0	6.6	0.83	50.61
1.083	0.03	0.1	3.8	5.0	0.59	50.50
1.167	0.02	0.1	3.0	3.9	0.43	50.39
1.250	0.00	0.0	2.4	3.1	0.31	50.32

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: C:\PONDPACK\STJOE4 .PND
Inflow Hydrograph: C:\PONDPACK\STJOE4 .HYD
Outflow Hydrograph: C:\PONDPACK\OUT .HYD

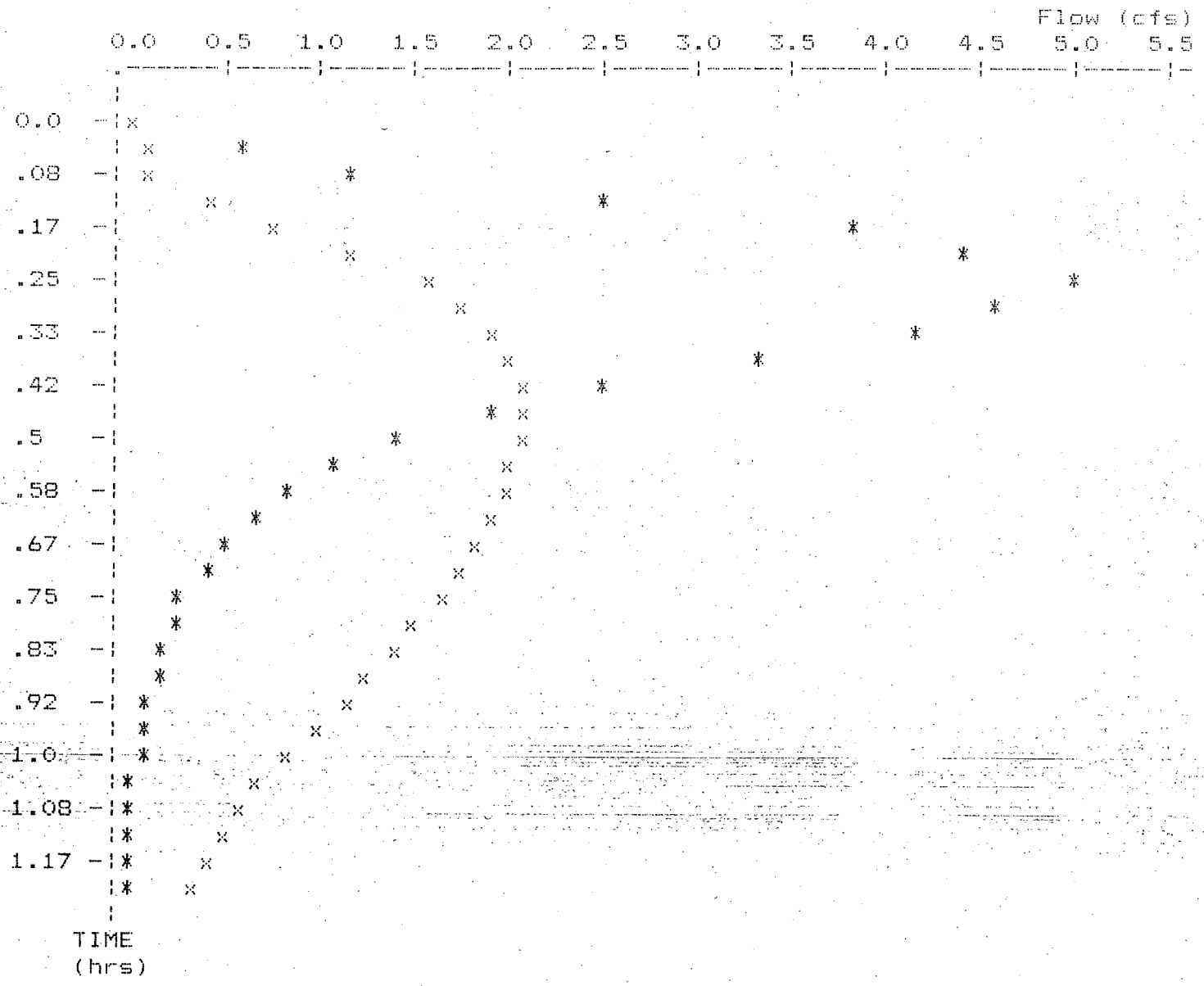
Starting Pond W.S. Elevation = 50.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	4.99 cfs
Peak Outflow	=	2.08 cfs
Peak Elevation	=	51.57 ft

***** Summary of Approximate Peak Storage *****

Initial Storage	=	0.00 ac-ft
Peak Storage From Storm	=	0.07 ac-ft
Total Storage in Pond	=	0.07 ac-ft



* File: C:\PONDPACK\STJOE4 .HYD Qmax = 5.0 cfs
× File: C:\PONDPACK\OUT .HYD Qmax = 2.1 cfs