

## **PRELIMINARY DRAINAGE STUDY**

**COMOTARA POWER CENTER  
36th and North Rock Road  
Wichita, Kansas**

**Return Frequency of  
10-year, 100-year Design Storm**

**Program Methods:  
Texas Hydraulic System (Rational Method)  
Pond2 and PondPak (Haested)**

**Reference:  
Calculation & Drainage Information for  
Upstream Condition  
by Mid-Kansas Engineering Consultants  
Design of Urban Highway Design Manual 1  
Drainage of Highway Pavements Manual 2  
Interim Drainage and Storm Sewer Policy  
for Design Criteria and Documentation**

**Prepared by**

**KAW VALLEY ENGINEERING  
April 1992**

**KAW VALLEY  
ENGINEERING**

• ENGINEERING • ARCHITECTURE • PLANNING • SURVEYING • INSPECTION • TESTING •

2310 N. Jackson • P. O. Box 1304 • Junction City, Kansas 66441 • 913/762-5040

**GRANT OF STORM DRAINAGE EASEMENT**

STATE OF KANSAS, COUNTY OF SEDGWICK:

For and in consideration of One Dollar (\$1.00) and other good and valuable consideration to the undersigned owner paid, the receipt of which is hereby acknowledged; the undersigned hereby grants to the CITY OF WICHITA, KANSAS, a municipal corporation located in Sedgwick County, Kansas, and its successors and assigns, a permanent and perpetual easement and right-of-way to construct, maintain, repair and replace storm drainage channel and underground pipelines and appurtenances within, on and under the following described tract of real estate located in Sedgwick County, Kansas, and described as follows, to-wit:

See attached legal description.

together with the right of ingress and egress for all purposes incident to said grant.

The said Grantor, its successors and assigns, hereby agrees that no building, buildings or other structures shall be erected on or over the above described easement, but are otherwise to fully use and enjoy said premises except for the purposes hereinbefore granted to said grantee.

This Grant of Easement shall run with the land and is binding upon the heirs, representatives, successors and assigns of the respective parties hereto.

IN WITNESS WHEREOF:

Northrock Realty Partners, the Grantor herein, has caused to execute this instrument this \_\_\_\_ day of \_\_\_\_\_, 19\_\_.

ATTEST:

BY:

\_\_\_\_\_

\_\_\_\_\_  
David C Nesbitt, Partner  
Northrock Realty Partners

STATE OF KANSAS, COUNTY OF SEDGWICK ss:

The foregoing Grant of Easement and right-of-way was acknowledged before me this \_\_ day of \_\_\_\_\_, 19\_\_.

\_\_\_\_\_

Notary Public

July 10, 1992  
92-1399

#### DESCRIPTION FOR STORM DRAINAGE EASEMENT

A tract of land for storm drainage easement located in the Northeast Quarter of Section 31, Township 26 South, Range 2 East of the 6th Principal Meridian, Sedgwick County, Kansas and being a portion of Killarney Plaza Second Addition more particularly described as follows:

Commencing at the Northwest corner of Lot 2, Block 1 Comotara Power Center; thence S 01°04'59" E on the West line of said Comotara Power Center a distance of 110.48 feet to the POINT OF BEGINNING of tract to be described:

thence continuing on said West line S 01°04'59" E a distance of 563.05 feet;

thence N 42°04'31" W a distance of 556.67 feet to the South Right-of-Way line of Inwood;

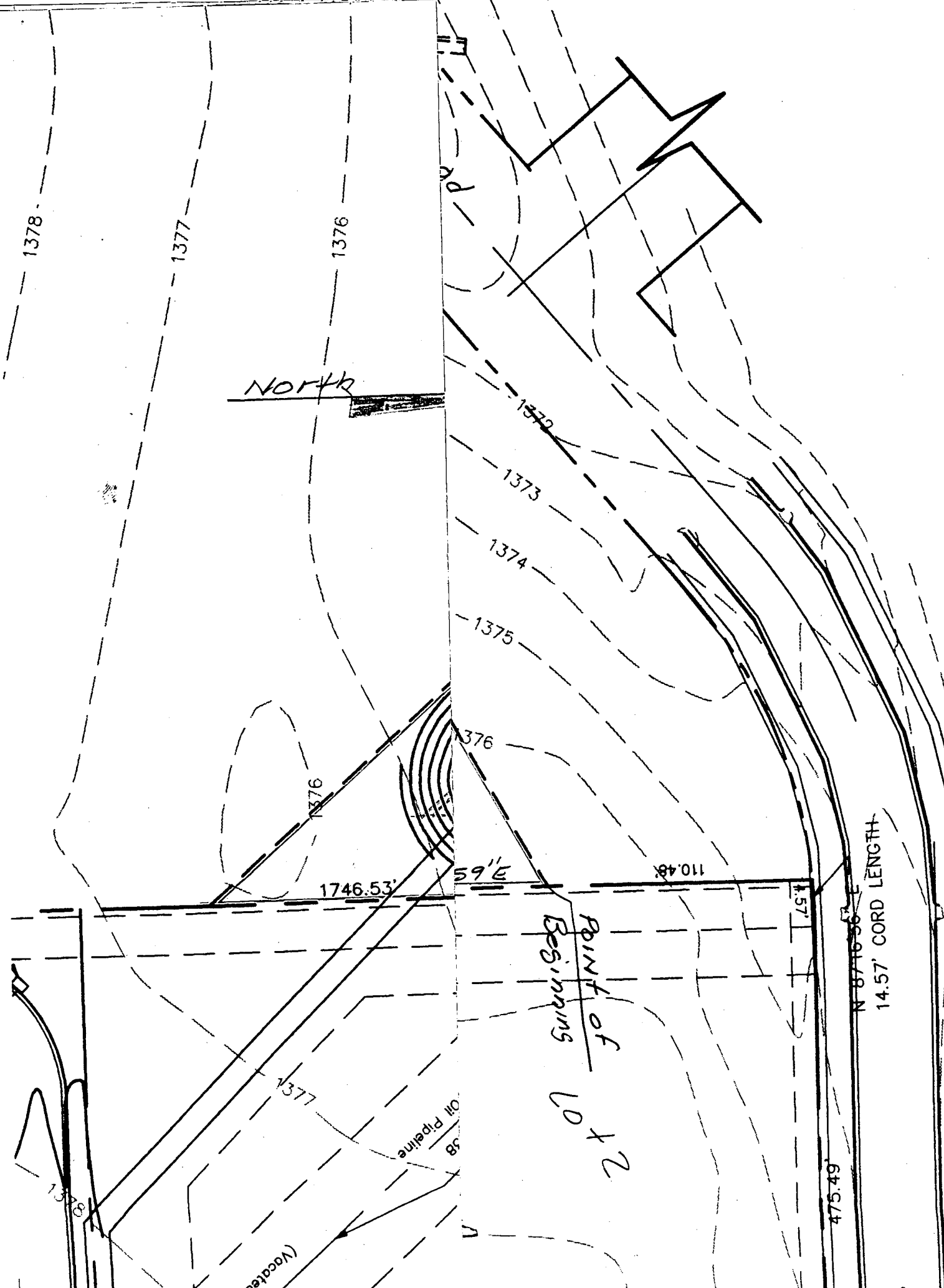
thence N 49°00'00" E on said South Right-of-Way line a distance of 110.00 feet;

thence S 42°04'31" E a distance of 74.69 feet;

thence N 59°52'45" E a distance of 265.19 feet to the Point of Beginning.

Contains 2.29 acres, more or less.

END OF DESCRIPTION



1378

1377

1376

NORTH

1372

1373

1374

1375

1376

1376

1746.53'

59' E

110.48'

1.57'

N 87° 16' 36" E  
14.57' CORD LENGTH

475.49'

POINT of  
BEGINNING  
10 x 2

Oil Pipeline  
38"

1377

(Vacated)

# KAW VALLEY ENGINEERING & DEVELOPMENT, INC.

2319 NORTH JACKSON  
P.O. BOX 1304  
JUNCTION CITY, KANSAS 66441  
TEL: (913) 762-5040  
FAX: (913) 762-7744

122 NW PARKWAY  
RIVERSIDE, MISSOURI 64150  
TEL: (816) 587-5033  
FAX: (816) 587-0129

June 5, 1992  
92-1399

City of Wichita  
Engineering Department  
455 N Main, 7th Floor  
Wichita, KS 67202

ATTN Vicky Huang, P E

RE Commercial Development Site at 36th and North  
Rock Road, Wichita, Kansas

Dear Vicky

As you discussed with Leon Osbourn of this office we have reexamined the storm drainage study originally provided you on the above referenced project to estimate the effects of detaining the storm water from the proposed development of this 45-acre site. Although it is possible as we originally stated, that continuing to add detention storage for each site in the development may result in a higher maximum discharge at some specific given point somewhere downstream, we believe it is still necessary to provide some detention to store the increased runoff from this site.

An analysis of the watershed to determine water surface elevations at specific points in time and specific locations downstream would require a large amount of data and study, which we believe is far beyond the scope of an individual development. We have therefore, completed a preliminary design to size detention storage to retain the additional runoff from a storm of 100-year frequency that would occur after this 45-acre site is fully developed.

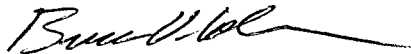
The runoff from the existing condition of the site is estimated at 158 cfs, and when fully developed with all paving, streets, and buildings in place, it is estimated that this could increase to 382 cfs from a storm of 100-year frequency. To detain that difference requires a detention storage of 8.1 acre/feet. This can be achieved by constructing a dry detention basin immediately upstream from the box bridge on Inwood. As stated in the original report, the water discharging from the existing detention basins East of Rock Road would be passed through without further detention, and only the increased runoff from this site would be detained in a normally dry detention basin.

City of Wichita  
ATTN Vicky Huang, P E  
June 5, 1992 - Page 2 -

The above quantities are preliminary estimates and are conservative, based on preliminary storm drainage and site development plans. It is believed that the final design of the detention storage will result in somewhat less volume, and construction of that facility will provide the downstream protection, which leaves the greatest flexibility for other storm water management decisions in the watershed.

We sincerely appreciate your assistance in this project; and please allow us the opportunity to respond to any questions or comments you may have.

Sincerely



Bruce V Collins, P E  
Project Engineer

BVC/js

**PRELIMINARY DRAINAGE STUDY**

**COMOTARA POWER CENTER  
36th and North Rock Road  
Wichita, Kansas**

**Return Frequency of 10-year, 100-year Design Storm**

**Program Methods:**

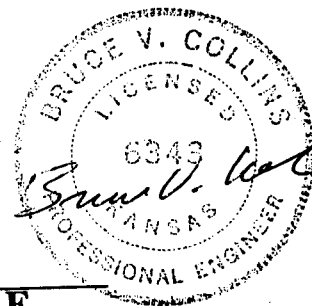
**Texas Hydraulic System (Rational Method)  
Pond2 and PondPak (Haested)**

**Reference:**

**Calculation & Drainage Information for  
Upstream Condition  
by Mid-Kansas Engineering Consultants  
Design of Urban Highway Design Manual 1  
Drainage of Highway Pavements Manual 2  
Interim Drainage and Storm Sewer Policy  
for Design Criteria and Documentation**

**Prepared by**

**KAW VALLEY ENGINEERING  
April 1992**



**Bruce V Collins, P E**

## **PRELIMINARY DRAINAGE STUDY**

**Project: Proposed Commercial Site  
36th and Rock Road, Wichita, Kansas**

**Subject: Storm Drainage Improvements and Runoff Calculations**

### **South Tract**

This proposed site is a 27.8-acre tract undeveloped and currently covered with grass, brush and some wheat. There has been prior installation of water and sewer lines across portions of the tract, which is otherwise vacant. The proposed improvement of the tract contemplates construction of retail stores and parking, which will essentially result in some 95% of the area becoming impermeable to storm water. Existing ditches and portions of an existing pond will be filled and replaced with storm drainage facilities and relocated detention areas.

In the investigation of the effect of storm water runoff of this proposed development, the following was assumed.

1. A detention pond currently exists upstream from this site on the East side of Rock Road. Per calculations and information furnished by Mid-Kansas Engineering Consultants, the design discharge through the 8 x 3 reinforced concrete box culvert on to this site is 130 cfs. Since it is assumed that this is the effluent from a properly designed and sized detention pond, this storm water runoff discharge will be passed through the subject site without further detention.
2. The time of concentration on the aforementioned storm water runoff was given as 26 minutes.
3. No other off site storm runoff discharge was considered.
4. Attempts to obtain storm water drainage reports for the developments East of Rock Road were unsuccessful.

Although the City of Wichita requires storm drainage to be designed for 5-year storm frequencies, the proposed developer of this tract requires a 10-year design in storm sewers, and the higher frequencies passed (without damage to any buildings) overland. Therefore, storm sewers were located and sized as per the attached drawing labeled as a grading plan and the attached calculations. These calculations indicate a maximum discharge from the site as improved, of 143 cfs for the storm of 10-year frequency, and 200 cfs for the storm of 100-year frequency.

As per the "Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation for the City of Wichita," herinafter referred to as "the Policy," the runoff from the unimproved site was analyzed by SCS TR 55 methods, to provide quick estimates of probable size of detention ponds. This method yielded a 10-year storm discharge of 60 cfs and a 100-yr storm discharge of 99 cfs. With the proposed discharge of 143 cfs from the 10-year storm, this would require a 3.8-acre/feet of storage volume, and the calculated discharge from the proposed condition of 200 cfs for the 100-year storm would require a 5.0-acre/feet of detention storage volume.

## **North Tract**

The north portion of this proposed development is a currently vacant tract of 18.54 acres. Existing ground cover is primarily grass with some brush. The projected improvement of the tract contemplates construction of commercial buildings and parking. The existing ditches and small pond would be replaced with storm sewers and storm runoff presently entering the site from detention structures east of Rock Road will be passed through the site in a large RCB structure.

The same assumptions stated previously apply to the North tract except the runoff entering from East of Rock Road has a listed discharge (Q100) of 350 cfs at a Tc of 35 minutes.

Again for estimate purposes, runoff from the existing and the improved site was analyzed by SCS TR55 methods, indicating the discharges stated on the attached summary. Calculations are also enclosed herewith.

### Total Tract

Total development of this tract of land routes stormwater runoff from East of Rock Road through the site as previously mentioned adding the additional runoff of the improved site, and passing this water downstream to the West to a new structure being designed across Inwood Road. Detention structures were sized to retain the differential runoff of the site.

The estimates of required volume are:

	South	North	Total
10 yr freq.	3.8 af	1.5 af	5.3 af
100 yr freq.	5.0 af	2.2 af	7.2 af

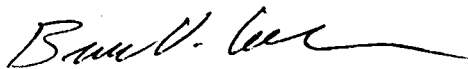
There is, however, with substantial storm water runoff entering the site from the East, the importance of the consideration of times of concentration. Because of the detention East of Rock Road, the Tc has been reported as 26 to 35 minutes. Calculations from the storm sewer design reports attached herewith for the proposed site indicate that the Tc for the site is only 6.5 minutes. It is therefore probable that storm water runoff from this proposed site if detained, results in matching peak runoff from the area East of Rock Road as the storm water passes through the existing detention ponds there.

Because of the relative Tc of each area, it is therefore recommended that the storm water runoff from the proposed site be allowed to pass downstream undetained to clear downstream channels of this runoff, prior to the runoff from already detained storm water to the East.

## Summary

In summary, although it is relatively easy to construct detention ponds to retain some of the peak runoff from this site, it would appear that this would defeat the long-term goals of spreading out the peak storm water discharges downstream. Should storm drainage detention be required, the discharge from the two sites can be combined in that detention storage.

We would be pleased to respond to any questions, comments, or requests for additional information.



**BRUCE V COLLINS**  
Professional Engineer

## STORM RUNOFF SUMMARY

### A. NORTH TRACT

	Q 10 cfs	Q 100 cfs	T c min
1. From East of Rock Road per MKEC calculations	220*	350	35
2. From North tract devel. Detained	54	67	
Undetained	137	165	6
3. Total Peak Q W/ detention	274	417	
W/O detention	220	350	

### B. SOUTH TRACT

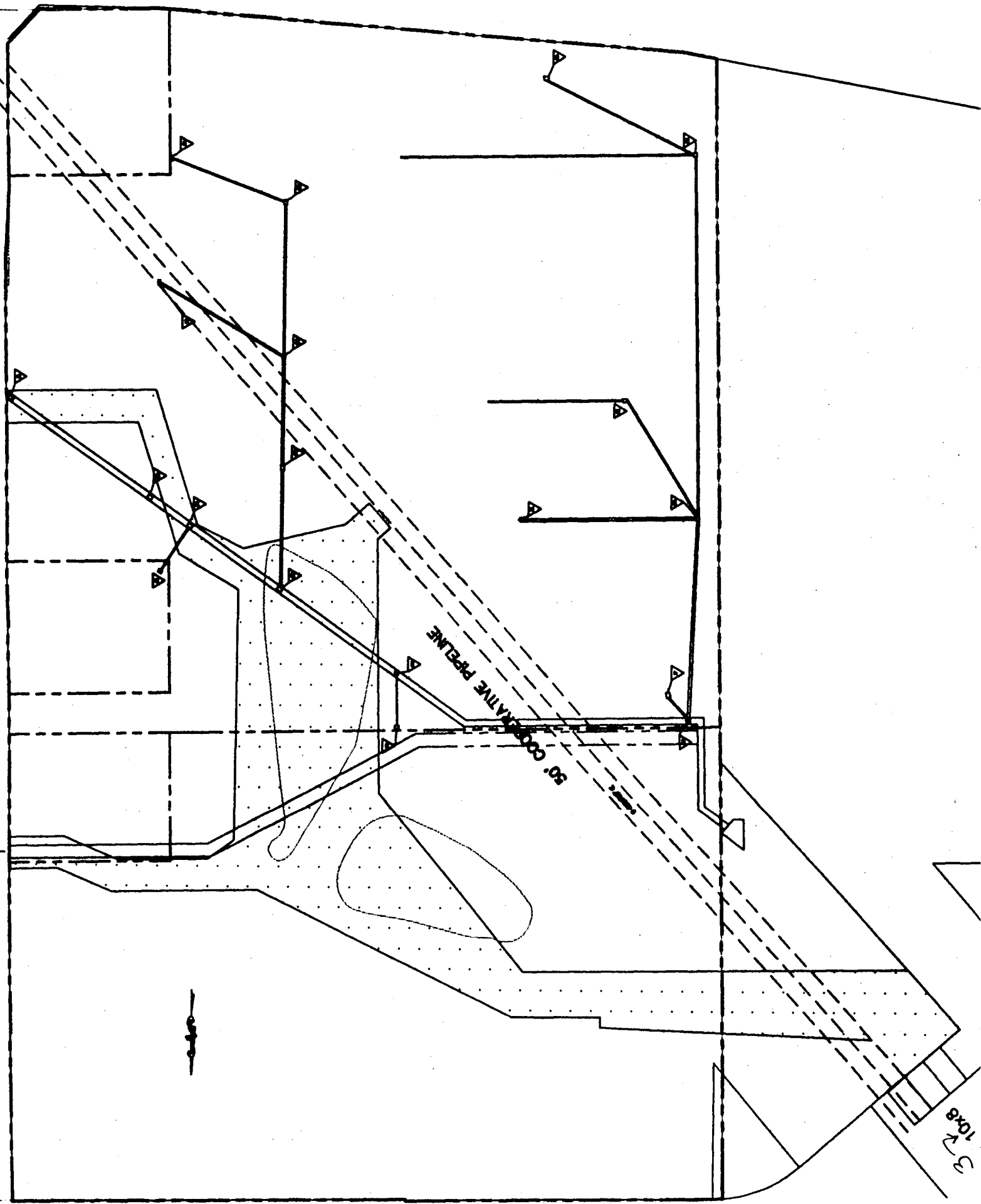
1. From East of Rock Road per MKEC calculations	81*	130	26
2. From South tract devel. Detained	60	99	
Undetained	143	200	6.5
3. Total Peak Q W/ detention	141	229	
W/O detention	143	200	

### C. TOTAL DOWNSTREAM PEAK DISCHARGE

With Detention	415	646
Without Detention	363	550

NOTE; Exact amounts will change with final designs, but the differential proportions are expected to be similar.

OF ROAD



10x8  
C  
R  
W

**South Tract Calculations**

>>>> DETENTION STORAGE ESTIMATE <<<<<

DETENTION POND SIZE ESTIMATES

BVC 4-17-92 1399

CALCULATED  
DISK FILE: A:399 .DET

*South Tract*

Drainage Area (acres) 27.8 0.0434 sq.mi.  
Rainfall Distribution (Type) II

	Storm #1	Storm #2	Storm #3
Frequency (years)	5	10	100
Peak Inflow, qi (cfs)	130	143	200
Inflow Runoff, Q (in)	0.79	5.26	7.76
Peak Outflow, qo (cfs)	49	60	99
qo/qi Ratio	0.377	0.420	0.495
* Vs/Vr Ratio	0.333	0.311	0.278
Inflow Volume, Vr (ac-ft)	1.8	12.2	18.0
STORAGE VOLUME, Vs (ac-ft)	0.6	3.8	5.0

Summary of Volume Computations

C0	0.682	0.682	0.682
C1	-1.430	-1.430	-1.430
C2	1.640	1.640	1.640
C3	-0.804	-0.804	-0.804
* Vs/Vr	0.333	0.311	0.278

$$* \text{ Vs/Vr} = C0 + ( C1 * (\text{qo/qi}) ) + ( C2 * (\text{qo/qi}) ) + ( C3 * (\text{qo/qi}) )$$

Storm Sewer size  
Rational Formula  
South Tract

1/4

```

*****
# THYSYS S/M : 1393300036
# HMVersion : 3.31
# Date : 4/17/92
# KAW VALLEY ENGINEERING
# Time : 17:03:36
# Input file : A:399-10.DAI
# Output file : A:399-10.RP2
*****

```

\$Storm Drainage, SAMS		Site, WICHITA, KS		10 yr Freq.		91-1399	
\$PROPOSED LINE A, E, B, D VALUES FROMTPNO. 40 CALC							
\$Kaw Valley Engineering, MAR 20, 1992 BVC							
SEWER	DESIGN	RUNOFF		INLET	SEWER	FREQUENCY=10 YR	
COEF	DESC	A=ROOF	B=PVT	C=TURF	D=RES	E=GRVL	
RAT	CDEF	0.98	0.95	0.30	0.40	0.70	MIN TC = 5.00.721 54.7 11.0
DA A 1				2.41	L	V	T 5 12 3
DA A 2	2.06				L	V	T 5
DA A 3	1.29				L	V	T 5
DA A 4	1.24				L	V	T 5
DA A 6	1.86				L	V	T 5
DA A 7	0.81				L	V	T 5
DA B 1				1.61	L	V	T 5
DA L 1					L	V	T 5
DA L 2				2.12	L	V	T 5
DA F 1				1.67	L	V	T 5
DA G 1	0.51				L	V	T 5
DA C 1	0.67	1.80			L	V	T 5
DA C 2	1.83				L	V	T 5
DA C 3	0.95	0.20			L	V	T 5
DA D 1	1.83				L	V	T 5
DA E 1	1.06				L	V	T 5
DA E 2	0.10	0.85			L	V	T 5
DA J 1				2.20	L	V	T 5
JUNC A 1	TYPE=6SA6						12.0
JUNC A 2	TYPE=6SA6						12.0
JUNC A 3	TYPE=6SA6						12.0
JUNC A 4	TYPE=6SA6				0.6	9.0	156
JUNC A 5	TYPE=JUNCT						157
JUNC A 6	TYPE=CSA6				0.6	7.0	158
JUNC A 7	TYPE=CSA6				0.6	7.0	159
JUNC A 8	TYPE=JUNCT						160
JUNC B 1	TYPE=CSA6				0.6	12.0	161
JUNC L 1	TYPE=6SA6					36.0	162
JUNC L 2	TYPE=6SA6					12.0	163
JUNC L 3	TYPE=JUNCT						164
JUNC F 1	TYPE=6SA6					12.0	165
JUNC G 1	TYPE=CURB	10.0	1.00	30.0	15.0	0.0150.6	166
JUNC J 1	TYPE=CSA6				0.6	9.0	167
JUNC C 1	TYPE=CSA6				0.6	12.0	168
JUNC C 2	TYPE=6SA6					20.0	169
JUNC D 1	TYPE=6SA6					20.0	171
JUNC C 3	TYPE=CSA6				0.6	12.0	172
JUNC E 1	TYPE=CSA6				0.6	12.0	173
JUNC E 2	TYPE=CSA6				0.6	12.0	180
OUTLET	STATIONING	1000.00	T.W.	ELEV	378.00	A B	195
DSGN 1	A 1 A 2	US 384.1	DS 383.5	190	0.010	24 CIRC	200
DSGN 2	A 2 A 3	US 383.5	DS 382.5	235	0.010	30 CIRC	202
DSGN 3	A 3 A 4	US 382.5	DS 381.7	170	0.010	30 CIRC	205
DSGN 4	A 4 A 5	US 381.7	DS 380.8	180	0.013	36 CIRC	205
DSGN 5	L 1 L 2	US 383.6	DS 382.0	290	0.013	3 BOX	210
DSGN 6	L 2 L 3	US 382.0	DS 381.66	70	0.013	3 BOX	215

185.0

- Pass thru from Q  
East of Kexle Rd.  
Estimated @ Max. capacity  
of existing PCB.  
Station Q from MKEC  
report = 180 cfs

DSGN	7	L	3	A	5	US	381.66	DS	380.79	170	0.013	3	BOX	217
DSGN	8	F	1	L	3	US	382.0	DS	381.66	80	0.010	24	CIRC	219
DSGN	9	A	5	A	6	US	380.8	DS	379.7	205	0.013	4	BOX	222
DSGN	10	6	1	A	6	US	380.5	DS	379.7	85	0.010	24	CIRC	223
DSGN	11	B	1	A	3	US	383.5	DS	382.5	225	0.010	24	CIRC	224
DSGN	12	A	6	A	7	US	379.7	DS	377.1	475	0.013	4	BOX	225
DSGN	13	J	1	A	7	US	377.3	DS	377.1	45	0.010	24	CIRC	227
DSGN	14	C	1	C	2	US	382.5	DS	381.4	260	0.010	24	CIRC	228
DSGN	15	C	2	C	3	US	381.4	DS	378.6	555	0.010	30	CIRC	230
DSGN	16	D	1	E	2	US	381.0	DS	379.0	200	0.010	24	CIRC	235
DSGN	18	E	1	E	2	US	379.9	DS	379.0	205	0.010	24	CIRC	242
DSGN	19	E	2	C	3	US	379.0	DS	378.6	35	0.010	30	CIRC	245
DSGN	20	C	3	A	7	US	378.6	DS	377.1	305	0.013	42	CIRC	255
DSGN	21	A	7	A	8	US	377.3	DS	376.7	100	0.013	4	BOX	267

ENDATA

SURFACE DESCRIPTION OF RATIONAL COEFFICIENTS

A	B	C	D	E	F
ROOF	PVMT	TURF	RES	GRVL	
.9800	.9500	.3000	.4000	.7000	.0000

MINIMUM TIME OF CONCENTRATION = 5.0 MINUTES

E = .721      B = 55.      D = 11.0

I.D.	CA	TC	SUPPLY Q	INTENSITY	TOTAL FLOW
A 1	1.69	5.00	.0	7.41	12.5
A 2	1.96	5.00	.0	7.41	14.5
A 3	1.23	5.00	.0	7.41	9.1
A 4	1.18	5.00	.0	7.41	8.7
A 6	1.77	5.00	.0	7.41	13.1
A 7	.77	5.00	.0	7.41	5.7
B 1	1.13	5.00	.0	7.41	8.4
L 1	.00	5.00	185.0	.00	185.0
L 2	1.48	5.00	.0	7.41	11.0
F 1	1.17	5.00	.0	7.41	8.7
G 1	.48	5.00	.0	7.41	3.6
C 1	1.36	5.00	.0	7.41	10.1
C 2	1.79	5.00	.0	7.41	13.3
C 3	.98	5.00	.0	7.41	7.3
D 1	1.79	5.00	.0	7.41	13.3
E 1	1.01	5.00	.0	7.41	7.5
E 2	.44	5.00	.0	7.41	3.2
J 1	1.54	5.00	.0	7.41	11.4
A 5	.00	.00	.0	.00	.0
A 8	.00	.00	.0	.00	.0
L 3	.00	.00	.0	.00	.0

INLET DESIGN

INLET I.D.	INLET TYPE	FLOW (CFS)	MINIMUM COMPUTED LENGTH REQUIRED (FT)	MINIMUM STANDARD LENGTH REQUIRED (FT)	STANDARD INLET OPENING (FT)	GRATE WIDTH (FT)	CARRYOVER (CFS)	CARRYOVER ASSIGNMENT INLET I.D.	MINIMUM AREA REQUIRED (SQ.FT.)	CALCULATED POND WIDTH (FT)
A 1	6SAG	12.5	.00	.0	.0	.0	.0	---	4.45	.00
A 2	6SAG	14.5	.00	.0	.0	.0	.0	---	5.16	.00
A 3	6SAG	9.1	.00	.0	.0	.0	.0	---	3.23	.00
A 4	6SAG	8.7	.00	.0	.0	.0	.0	---	3.59	.00
A 6	CSAG	13.1	3.30	.0	.0	.0	.0	---	.00	.00

A	7	CSAG	5.7	1.43	.0	.0	.0	.0	---	.00	.00
B	1	CSAG	8.4	1.34	.0	.0	.0	.0	---	.00	.00
L	1	6SAG	185.0	.00	.0	.0	.0	.0	---	38.03	.00
L	2	6SAG	11.0	.00	.0	.0	.0	.0	---	3.91	.00
F	1	6SAG	8.7	.00	.0	.0	.0	.0	---	3.08	.00
6	1	CURB	3.6	3.22	5.0	5.0	.0	.0	---	.00	8.26
C	1	CSAG	10.1	1.61	.0	.0	.0	.0	---	.00	.00
C	2	6SAG	13.3	.00	.0	.0	.0	.0	---	3.66	.00
C	3	CSAG	7.3	1.17	.0	.0	.0	.0	---	.00	.00
D	1	6SAG	13.3	.00	.0	.0	.0	.0	---	3.66	.00
E	1	CSAG	7.5	1.19	.0	.0	.0	.0	---	.00	.00
E	2	CSAG	3.2	.52	.0	.0	.0	.0	---	.00	.00
J	1	CSAG	11.4	2.36	.0	.0	.0	.0	---	.00	.00

SEWER DESIGN

CONFIGURATION DATA

RUN	U.S. D.S.		U.S.	D.S.	LENGTH	SLOPE	BBLs	RISE	SPAN	SHAPE		
	ID	ID	F.L. ELEV	F.L. ELEV								
1	A	1	A	2	382.10	381.50	190	.00316	1	24	24	CIRC
2	A	2	A	3	381.00	380.00	235	.00426	1	30	30	CIRC
3	A	3	A	4	380.00	379.20	170	.00471	2	30	30	CIRC
4	A	4	A	5	379.20	378.30	180	.00500	2	30	30	CIRC
5	L	1	L	2	380.60	379.00	290	.00552	2	3	5	BOX
6	L	2	L	3	379.00	378.66	70	.00486	2	3	5	BOX
7	L	3	A	5	378.66	377.79	170	.00512	2	3	5	BOX
8	F	1	L	3	380.50	380.16	80	.00425	1	18	18	CIRC
9	A	5	A	6	376.80	375.70	205	.00537	1	4	7	BOX
10	6	1	A	6	379.50	378.70	85	.00941	1	12	12	CIRC
11	B	1	A	3	382.00	381.00	225	.00444	1	18	18	CIRC
12	A	6	A	7	375.70	373.10	475	.00547	1	4	7	BOX
13	J	1	A	7	375.55	375.35	45	.00444	1	21	21	CIRC
14	C	1	C	2	380.75	379.65	260	.00423	1	21	21	CIRC
15	C	2	C	3	379.15	376.35	555	.00505	1	27	27	CIRC
16	D	1	E	2	379.50	377.50	200	.01000	1	18	18	CIRC
18	E	1	E	2	378.40	377.50	205	.00439	1	18	18	CIRC
19	E	2	C	3	377.00	376.60	35	.01143	1	24	24	CIRC
20	C	3	A	7	375.10	373.60	305	.00492	1	42	42	CIRC
21	A	7	A	8	373.30	372.70	100	.00600	1	4	8	BOX

185.00 d

HYDRAULIC DATA

RUN	U.S. D.S.		JUNC	FLOW	U.S.	D.S.	HYDR.	DEPTH	VELOC.	PIPE			
	ID	ID			HEAD	HEAD					GRAD		
1	A	1	A	2	.010	.00	12.50	383.72	383.38	.00181	.65	5.8	16.5
2	A	2	A	3	.010	.00	26.35	383.38	382.80	.00244	.65	7.8	34.8
3	A	3	A	4	.010	.00	42.44	382.80	382.53	.00158	.55	7.7	73.2
4	A	4	A	5	.013	.00	50.00	382.53	381.86	.00372	.72	6.6	58.0
ENTRANCE CONTROLS. TOTAL HEAD AT UPSTREAM END FOR RUN NO. 5 IS 3.52													
5	L	1	L	2	.013	.00	185.00	384.12	382.77	.00317	2.02	9.2	244.0
6	L	2	L	3	.013	.00	195.74	382.77	382.52	.00355	2.21	8.9	228.9
7	L	3	A	5	.013	.00	204.09	382.52	381.86	.00386	2.24	9.1	235.0
8	F	1	L	3	.010	.00	8.66	382.84	382.52	.00402	.80	5.7	8.9
9	A	5	A	6	.013	.00	252.24	381.86	380.94	.00450	3.09	11.7	275.3
10	6	1	A	6	.010	.00	3.59	381.45	380.94	.00601	.68	6.3	4.5
11	B	1	A	3	.010	.00	8.35	383.64	382.80	.00374	.75	5.9	9.1
12	A	6	A	7	.013	.00	266.68	380.94	378.55	.00503	3.20	11.9	278.1
13	J	1	A	7	.010	.00	11.41	378.69	378.55	.00307	.70	6.3	13.7
ENTRANCE CONTROLS. TOTAL HEAD AT UPSTREAM END FOR RUN NO. 14 IS 1.90													
14	C	1	C	2	.010	.00	10.05	382.65	381.07	.00238	.65	6.1	13.4
15	C	2	C	3	.010	.00	22.62	381.07	379.31	.00316	.67	8.0	28.6
ENTRANCE CONTROLS. TOTAL HEAD AT UPSTREAM END FOR RUN NO. 16 IS 3.28													
16	D	1	E	2	.010	.00	13.29	382.78	379.54	.00947	.80	8.8	13.7

18	E 1	E 2	.010	.00	7.46	380.15	379.54	.00299	.69	5.7	9.0
19	E 2	C 3	.010	.00	23.35	379.54	379.31	.00631	.64	11.0	31.4
20	C 3	A 7	.013	.00	50.41	379.31	378.55	.00251	3.63	7.8	70.6
21	A 7	A B	.013	.00	328.35	378.55	378.00	.00549	3.17	12.9	343.2

4/4

\* BOX DEPTHS IN FEET

328.35 - 185 = 143 cts from site

4-17-92  
BCL

*Existing Condition*

Quick TR-55 Ver.5.46 S/N:1315400181  
Executed: 09:30:12 04-17-1992

WICHITA,

4-17-92 1399

Tc BASED ON UNIMPROVED CONDITION  
SEE ATTACHMENT E, CITY OF WICHITA

Tc or Tt DATA  
.....

Subarea: SOUTH DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME	
			minutes	hours
UNIMPROVED SOUTH 1100 FT	1200	0.30	66.7	= 1.11
			minutes	hours
TOTAL Tc --->			66.7	= 1.11

.....

TR-55 TABULAR HYDROGRAPH METHOD  
 Type II. Distribution  
 (24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
 Watershed file: --> A:399E .MOP  
 Hydrograph file: --> A:399E5.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
SOUTH	27.80	85.0	1.00	0.00	4.80	3.18	1.07 .10

\* Travel time from subarea outfall to composite watershed outfall point.  
 I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 27.80 acres or 0.04344 sq.mi  
 Peak discharge = 49 cfs

>>>> Computer Modifications of Input Parameters <<<<

Subarea Description	Input Values		Rounded Values		Ia/p Interpolated	Ia/p Messages
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	(Yes/No)	
SOUTH	1.10	0.00	1.00	0.00	No	Computed Ia/p < .1

\* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
Watershed file: --> A:399E .MOP  
Hydrograph file: --> A:399E5.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
SOUTH	49	12.8
Composite Watershed	49	12.8

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
Watershed file: --> A:399E .MOP  
Hydrograph file: --> A:399E5.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
SOUTH	2	2	3	4	5	6	10	15	23
Total (cfs)	2	2	3	4	5	6	10	15	23

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
SOUTH	32	40	45	49	43	33	24	18	14
Total (cfs)	32	40	45	49	43	33	24	18	14

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
SOUTH	11	9	7	6	5	4	4	3	3
Total (cfs)	11	9	7	6	5	4	4	3	3

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
SOUTH	3	2	2	2	0
Total (cfs)	3	2	2	2	0

399E .MOP— Watershed inTypeII. 24hr Storm Hydrograph out —399E10.HYD

SOUTH TRACT EXISTING CONDITION

<u>Subarea Description</u>	<u>Peak Discharge at Composite Outfall (cfs)</u>	<u>Time to Peak at Composite Outfall (hrs)</u>
<u>SOUTH</u>	<u>60</u>	<u>12.8</u>
Composite Watershed	60	12.8

Press <Enter> to continue. Press <Esc> to exit printout.

399E .MOP— Watershed inTypeII. 24hr Storm Hydrograph out —399E100.HYD

SOUTH TRACT EXISTING CONDITION

<u>Subarea Description</u>	<u>Peak Discharge at Composite Outfall (cfs)</u>	<u>Time to Peak at Composite Outfall (hrs)</u>
<u>SOUTH</u>	<u>99</u>	<u>12.8</u>
Composite Watershed	99	12.8

Press <Enter> to continue. Press <Esc> to exit printout.

TR-55 TABULAR HYDROGRAPH METHOD  
 Type II. Distribution  
 (24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
 Watershed file: --> A:399E .MOP  
 Hydrograph file: --> A:399E25.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip.   (in)	Runoff (in)	Ia/p input/used
SOUTH	27.80	85.0	1.00	0.00	6.48	4.76	1.05 .10

\* Travel time from subarea outfall to composite watershed outfall point.  
 I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 27.80 acres or 0.04344 sq.mi  
 Peak discharge = 74 cfs

>>>> Computer Modifications of Input Parameters <<<<

Subarea Description	Input Values		Rounded Values		Ia/p	Ia/p Messages
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	
SOUTH	1.10	0.00	1.00	0.00	No	Computed Ia/p < .1

\* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
Watershed file: --> A:399E .MOP  
Hydrograph file: --> A:399E25.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
SOUTH	74	12.8
Composite Watershed	74	12.8

TR-55 TABULAR HYDROGRAPH METHOD  
 Type II. Distribution  
 (24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
 Watershed file: --> A:399E .MOP  
 Hydrograph file: --> A:399E25.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
SOUTH	2	3	4	6	7	10	15	23	35
Total (cfs)	2	3	4	6	7	10	15	23	35

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
SOUTH	48	60	68	74	65	49	36	27	21
Total (cfs)	48	60	68	74	65	49	36	27	21

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
SOUTH	17	13	10	8	7	6	5	5	4
Total (cfs)	17	13	10	8	7	6	5	5	4

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
SOUTH	4	4	3	2	0
Total (cfs)	4	4	3	2	0

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
Watershed file: --> A:399E .MOP  
Hydrograph file: --> A:399E100.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
SOUTH	27.80	85.0	1.00	0.00	8.16	6.37	1.04 .10

\* Travel time from subarea outfall to composite watershed outfall point.  
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 27.80 acres or 0.04344 sq.mi  
Peak discharge = 99 cfs

>>>> Computer Modifications of Input Parameters <<<<

Subarea Description	Input Values		Rounded Values		Ia/p Interpolated (Yes/No)	Ia/p Messages
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)		
SOUTH	1.10	0.00	1.00	0.00	No	Computed Ia/p < .1

\* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
Watershed file: --> A:399E .MOP  
Hydrograph file: --> A:399E100.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
SOUTH	99	12.8
Composite Watershed	99	12.8

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 04-17-1992 09:50:56  
Watershed file: --> A:399E .MOP  
Hydrograph file: --> A:399E100.HYD

WICHITA EXISTING CONDITION BVC 4-17-92 1399

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
SOUTH	3	4	6	8	10	13	20	31	46
Total (cfs)	3	4	6	8	10	13	20	31	46

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
SOUTH	64	80	91	99	87	66	48	37	28
Total (cfs)	64	80	91	99	87	66	48	37	28

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
SOUTH	23	17	14	11	9	8	7	6	6
Total (cfs)	23	17	14	11	9	8	7	6	6

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
SOUTH	6	5	4	3	0
Total (cfs)	6	5	4	3	0

\*\*\*\*\*

```

* RIDE S/N : *
* HMVersion : 1.10 *
* Date : 4/17/92 *
* Time : 16:53:24 *
* Input file : C:\HYDRO\THYSYS\SEDGWIC*
* Output file : A:SEDGWICK.EBD *

```

RIDE

Rainfall Intensity - Duration Equations

\$ SEDGWICK CO, KS

\$10 YEAR

```

RAIN
T= 5.      I= 7.41
T=10.     I= 6.09
T=15.     I= 5.22
T=30.     I= 3.76
T=60.     I= 2.53

```

RUN

Method Specified = RAIN - Calculated e,b,d

```

e = .721
b = 54.7
d = 11.0

```

For use in the equation:  $I = b / (tc+d)**e$

\$ 25 YEAR

```

RAIN
T= 5.      I= 8.52
T=10.     I= 7.04
T=15.     I= 6.06
T=30.     I= 4.39
T=60.     I= 2.98

```

RUN

Method Specified = RAIN - Calculated e,b,d

```

e = .710
b = 61.5
d = 11.2

```

\$ 50 YEAR

```

RAIN
T= 5.      I= 9.48
T=10.     I= 7.86
T=15.     I= 6.78
T=30.     I= 4.94
T=60.     I= 3.37

```

RUN

Method Specified = RAIN - Calculated e,b,d

2/2

e = .701  
b = 67.1  
d = 11.3

\$ 100 YEAR

RAIN

T= 5. I=10.32  
T=10. I= 8.54  
T=15. I= 7.37  
T=30. I= 5.40  
T=60. I= 3.73

RUN

Method Specified = RAIN - Calculated e,b,d

e = .663  
b = 62.4  
d = 10.1

**Kaw Valley Engineering  
& Development, Inc.**

2319 North Jackson  
P.O. Box 1304  
Junction City, Kansas 66441  
Tel: (913) 762-5040  
FAX: (913) 762-7744

122 NW Parkway  
Riverside, Missouri 64150  
Tel: (816) 587-5033  
FAX: (816) 587-0129

Job 1399  
Sheet No. \_\_\_\_\_ Of \_\_\_\_\_  
Calculated By BUC Date 4-16-92  
Checked By \_\_\_\_\_ Date \_\_\_\_\_  
Scale \_\_\_\_\_

Tc; PROPOSED SOUTH SITE

Most remote

300' sheet flow proposed pavement

to A-1  $1.4 \frac{1}{2}$  (300) = 3.6 min

to A-2 190/5.9 0.5

" A-3 235/8.0 0.5

A-4 170/2.9 0.4

A-5 180/6.7 0.4

A-6 205/11.8 0.3

A-7 475/12.0 0.7

A-8 100/11.1 0.1

6.5 min

**North Tract Calculations**

>>>> DETENTION STORAGE ESTIMATE <<<<<

NORTH TRACT, WICHITA, ESTIMATE OF STORAGE REQUIRED 1399  
 BASED ON PROJECTED FULL COMM. DEVELOPMENT, BVC 4-21-92

CALCULATED  
 DISK FILE: B:399N .DET

Drainage Area (acres) 18.5 0.0289 sq.mi.  
 Rainfall Distribution (Type) II

	Storm #1	Storm #2	Storm #3
Frequency (years)	10	25	100
Peak Inflow, qi (cfs)	137	165	214
Inflow Runoff, Q (in)	4.71	5.66	7.32
Peak Outflow, qo (cfs)	54	67	90
qo/qi Ratio	0.394	0.406	0.421
* Vs/Vr Ratio	0.324	0.318	0.311
Inflow Volume, Vr (ac-ft)	7.3	8.7	11.3
STORAGE VOLUME, Vs (ac-ft)	2.4	2.8	3.5

Summary of Volume Computations

C0	0.682	0.682	0.682
C1	-1.430	-1.430	-1.430
C2	1.640	1.640	1.640
C3	-0.804	-0.804	-0.804
* Vs/Vr	0.324	0.318	0.311

$$* \text{ Vs/Vr} = \text{C0} + \left( \text{C1} * \left( \frac{\text{qo}}{\text{qi}} \right) \right) + \left( \text{C2} * \left( \frac{\text{qo}}{\text{qi}} \right) \right) + \left( \text{C3} * \left( \frac{\text{qo}}{\text{qi}} \right) \right)$$

Graphical Peak Discharge File Used for Inflow Data:  
 B:399NP .GPD  
 Graphical Peak Discharge File Used for Outflow Data:  
 B:399NE .GPD

Quick TR-55 Version: 5.46 S/N: 1315400181

>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<

WICHITA-NORTH SITE, PROJECTED WITH COMMERCIAL DEVELOPMENT  
 1399-KVE-BVC 4-21-92-1399

CALCULATED  
 DISK FILE: B:399NF .GPD

Drainage Area (acres) 18.5 ---> 0.0289 sq.mi.  
 Runoff Curve Number (CN) 93  
 Time of Concentration, Tc (hrs) 0.1  
 Rainfall Distribution (Type) II  
 Pond and Swamp Areas (%) 0 ---> 0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	10	25	100
Rainfall, P, 24-hr (in)	5.52	6.48	8.16
Initial Abstraction, Ia (in)	0.151	0.151	0.151
Ia/p Ratio	0.027	0.023	0.018
Unit Discharge, * qu (csm/in)	1010	1010	1010
Runoff, Q (in)	4.71	5.66	7.32
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	137	165	214

Summary of Computations for qu

Ia/p #1	0.100	0.100	0.100
C0 #1	2.553	2.553	2.553
C1 #1	-0.615	-0.615	-0.615
C2 #1	-0.164	-0.164	-0.164
qu (csm) #1	1009.997	1009.997	1009.997
Ia/p #2	0.100	0.100	0.100
C0 #2	2.553	2.553	2.553
C1 #2	-0.615	-0.615	-0.615
C2 #2	-0.164	-0.164	-0.164
qu (csm) #2	1009.997	1009.997	1009.997
* qu (csm)	1010	1010	1010

\* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)  
 If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

$$qp \text{ (cfs)} = qu \text{ (csm)} * \text{Area (sq. mi.)} * 0.000708 * (\text{Pond \& Swamp Adj.})$$

Quick TR-55 Version: 5.46 S/N: 1315400181

>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<<

WICHITA-NORTH TRACT, EXISTING CONDITION  
KVE-BVC-1399

CALCULATED  
DISK FILE: B:399NE .GPD

Drainage Area	(acres)	18.5	---	>	0.0289 sq.mi.
Runoff Curve Number	(CN)	85			
Time of Concentration, Tc	(hrs)	0.3			
Rainfall Distribution	(Type)	II			
Pond and Swamp Areas	(%)	5	---	>	0.9 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	10	25	100
Rainfall, P, 24-hr (in)	5.52	6.48	8.16
Initial Abstraction, Ia (in)	0.353	0.353	0.353
Ia/p Ratio	0.064	0.054	0.043
Unit Discharge, * qu (csm/in)	676	676	676
Runoff, Q (in)	3.85	4.76	6.37
Pond & Swamp Adjustment Factor	0.72	0.72	0.72
PEAK DISCHARGE, qp (cfs)	54	67	90

Summary of Computations for qu

Ia/p	#1	0.100	0.100	0.100
C0	#1	2.553	2.553	2.553
C1	#1	-0.615	-0.615	-0.615
C2	#1	-0.164	-0.164	-0.164
qu (csm)	#1	676.110	676.110	676.110
Ia/p	#2	0.100	0.100	0.100
C0	#2	2.553	2.553	2.553
C1	#2	-0.615	-0.615	-0.615
C2	#2	-0.164	-0.164	-0.164
qu (csm)	#2	676.110	676.110	676.110
* qu (csm)		676	676	676

\* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)  
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

2

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc)))$$

$$qp \text{ (cfs)} = qu(\text{csm}) * \text{Area}(\text{sq.mi.}) * Q(\text{in.}) * (\text{Pond \& Swamp Adj.})$$

