

**Drainage Study**

**I-135 POWER CENTER  
Interstate 135 & Hydraulic Avenue**

Prepared for

**CITY OF WICHITA  
455 North Main  
7th Floor  
Wichita, Kansas 67202  
PH: 316-268-4736**

**July 1994  
94-1598**

**KAW VALLEY  
ENGINEERING**

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July 29, 1994  
94-1598

**DRAINAGE STUDY  
I-135 POWER CENTER  
INTERSTATE 135 & HYDRAULIC AVENUE  
WICHITA, KANSAS**

The proposed site is a 38.5 acre tract of undeveloped land. The site is presently covered with grass, brush and some trees. At this time these are the only 2 developments planned for the subdivision. A manufacturing facility is planned for Lot 1 and a fast food restaurant is proposed for Lot 5.

The present drainage pattern is to the southeast intercepting the drainage along Interstate 135. This ditch then drains to a 42" CMP under I-135 with an ultimate destination of the Arkansas River. The original drainage pattern has been altered with the construction of a ditch in the eastern portion of the site. This ditch prohibits low level run-off from entering the 42" CMP and instead channels it northeast to an existing lake. Run-off ponding above elevation 87, presently flows through the existing 42" CMP.

This drainage study will be split into 2 parts. The first part being what affect the initial development of Lots 1 and 5 has on the storm water run-off and the second part being what affect the ultimate development of the entire site has on the run-off.

Several assumptions were made in regards to this study.

1. The man made drainage ditch changed the original drainage pattern for water supply storage and therefore is ignored.
2. The entire site drains to the 42" CMP under I-135.
3. The detention pond will outlet to a structure under I-135.

**INITIAL DEVELOPMENT**

Initially there are plans for construction of a 25,000 square foot manufacturing facility on Lot 1 as well as a fast food restaurant on Lot 5.

As per the "Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation for the City of Wichita" the run-off from the site was analyzed by SCS TR 55 methods, to provide quick estimates of a probable size of detention ponds. The results of these calculations are summarized below for the 5 and 100 year storm.

	<b>5 Year Storm</b>	<b>100 Year Storm</b>
Predeveloped Run-Off	5 cfs	13 cfs
Developed Run-Off	37 cfs	71 cfs
Detention Required	1.4 Ac Ft	2.4 Ac Ft

The above results only reflect the run-off from the manufacturing facility. In conjunction with development of this facility a small detention pond would be constructed with the outlet being to the existing drainage ditch across the east portion of the site.

Due to the much smaller area involved, the run-off from Lot 5 will be allowed to run off undetained to the northeast as it presently does. The Lot 5 run-off is summarized below.

	<b>5 Year Storm</b>	<b>100 Year Storm</b>
Predeveloped	2 cfs	6 cfs
Developed	6 cfs	12 cfs

### **ULTIMATE DEVELOPMENT**

Some additional assumptions needed to be made in order to predict the ultimate increase in run-off.

1. Lot 2 will be developed with 75% of it being impervious.
2. Lots 3 and 4 will be developed with 90% being impervious.

Again, using SCS TR 55 methods, the run-off from the entire site, as well as an estimate of required detention storage was calculated. The run-off and estimated detention volumes are summarized below.

	<b>5 Year Storm</b>	<b>100 Year Storm</b>
Predeveloped Run-Off	22 cfs	57 cfs
Developed Run-Off	162 cfs	308 cfs
Detention Required	6.1 Ac Ft	10.5 Ac Ft

The detention pond would be constructed in the northeast corner of the site. In order to handle the 100 year outflow a pipe would need to be bored underneath I-135. The principle outlet from the pond, as well as the overflow, would be channeled through the new structure to the Arkansas River. Depending on the developed storm drainage system and required flow line elevations, the principle outlet may require the installation of a lift station.

**SUMMARY**

The size of the detention ponds are only estimates at this time. As the development plans are finalized a more accurate picture of the run-off and detention requirements will be calculated. However, what we have presented in this report is worst case scenario.

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



Samuel D Malinowsky, P E  
Project Engineer

SDM/dh

Quick TR-55 Version: 5.46 S/N:

>>>> DETENTION STORAGE ESTIMATE <<<<

I 135 Power Center, Wichita  
Developed Conditions  
Entire Site

CALCULATED  
DISK FILE: 598-SITE.DET

Drainage Area (acres) 29.5 0.0461 sq.mi.  
Rainfall Distribution (Type) II

	Storm #1	Storm #2	Storm #3
	-----	-----	-----
Frequency (years)	5	25	100
Peak Inflow, qi (cfs)	124	180	236
Inflow Runoff, Q (in)	3.68	5.33	7
Peak Outflow, qo (cfs)	17	29	43
qo/qi Ratio	0.137	0.161	0.182
* Vs/Vr Ratio	0.515	0.491	0.471
Inflow Volume, Vr (ac-ft)	9.0	13.1	17.2
STORAGE VOLUME, Vs (ac-ft)	4.7	6.4	8.1

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	0.515	0.491	0.471

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

Graphical Peak Discharge File Used for Inflow Data:  
598-POST.GPD  
Graphical Peak Discharge File Used for Outflow Data:  
598-PRE .GPD

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

I 135 Power Center, Wichita  
 Developed Conditions  
 Soap Factory Only

CALCULATED  
 DISK FILE: 598-SOAP.DET

Drainage Area (acres) 8.84 0.0138 sq.mi.  
 Rainfall Distribution (Type) II

	Storm #1	Storm #2	Storm #3
	-----	-----	-----
Frequency (years)	5	25	100
Peak Inflow, qi (cfs)	37	54	71
Inflow Runoff, Q (in)	3.68	5.33	7
Peak Outflow, qo (cfs)	5	9	13
qo/qi Ratio	0.135	0.167	0.183
* Vs/Vr Ratio	0.517	0.485	0.470
Inflow Volume, Vr (ac-ft)	2.7	3.9	5.2
STORAGE VOLUME, Vs (ac-ft)	1.4	1.9	2.4

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	0.517	0.485	0.470

$$* \text{ Vs/Vr} = C0 + ( C1*(qo/qi) ) + ( C2*(qo/qi)^2 ) + ( C3*(qo/qi)^3 )$$

Graphical Peak Discharge File Used for Inflow Data:  
 598SP-PO.GPD  
 Graphical Peak Discharge File Used for Outflow Data:  
 598SP-PR.GPD

Quick TR-55 Version: 5.46 S/N:

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

I 135 Power Center, Wichita  
Predeveloped Conditions  
Entire Site

CALCULATED  
DISK FILE: 598-PRE .GPD

Drainage Area (acres) 38.5 ---> 0.0602 sq.mi.  
Runoff Curve Number (CN) 70  
Time of Concentration, Tc (hrs) 2.3  
Rainfall Distribution (Type) II  
Pond and Swamp Areas (%) 0 ---> 0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	5	25	100
Rainfall, P, 24-hr (in)	4.8	6.5	8.2
Initial Abstraction, Ia (in)	0.857	0.857	0.857
Ia/p Ratio	0.179	0.132	0.105
Unit Discharge, * qu (csm/in)	190	198	203
Runoff, Q (in)	1.89	3.21	4.64
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	22	38	57

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	203.827	203.827	203.827
Ia/p #2	0.300	0.300	0.300
C0 #2	2.465	2.465	2.465
C1 #2	-0.623	-0.623	-0.623
C2 #2	-0.117	-0.117	-0.117
qu (csm) #2	167.829	167.829	167.829
* qu (csm)	190	198	203

\* 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.

$$\log(\text{qu}) = \text{C0} + (\text{C1} * \log(\text{Tc})) + (\text{C2} * (\log(\text{Tc}))^2)$$
$$\text{qp (cfs)} = \text{qu(csm)} * \text{Area(sq.mi.)} * \text{Q(in.)} * (\text{Pond \& Swamp Adj.})$$

Quick TR-55 Version: 5.46 S/N:

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

I 135 Power Center, Wichita  
Developed Conditions  
Entire Site

CALCULATED  
DISK FILE: 598-POST.GPD

Drainage Area (acres) 38.5 ---> 0.0602 sq.mi.  
Runoff Curve Number (CN) 90  
Time of Concentration, Tc (hrs) .25  
Rainfall Distribution (Type) II  
Pond and Swamp Areas (%) 0 ---> 0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	5	25	100
Rainfall, P, 24-hr (in)	4.8	6.5	8.2
Initial Abstraction, Ia (in)	0.222	0.222	0.222
Ia/p Ratio	0.046	0.034	0.027
Unit Discharge, * qu (csm/in)	731	731	731
Runoff, Q (in)	3.68	5.33	7.00
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	162	235	308

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	731.328	731.328	731.328
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	731.328	731.328	731.328
* qu (csm)	731	731	731

\* 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.

$$\log(\text{qu}) = C0 + (C1 * \log(\text{Tc})) + (C2 * (\log(\text{Tc}))^2)$$
$$\text{qp (cfs)} = \text{qu(csm)} * \text{Area(sq.mi.)} * \text{Q(in.)} * (\text{Pond \& Swamp Adj.})$$

Quick TR-55 Version: 5.46 S/N:

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

I 135 Power Center, Wichita  
Predeveloped Conditions  
Soap Factory Only

CALCULATED  
DISK FILE: 598SP-PR.GPD

Drainage Area (acres) 8.84 ---> 0.0138 sq.mi.  
Runoff Curve Number (CN) 70  
Time of Concentration, Tc (hrs) 2.3  
Rainfall Distribution (Type) II  
Pond and Swamp Areas (%) 0 ---> 0.0 acres

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Runoff, Q (in)	1.89	3.21	4.64
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	5	9	13

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
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C0 #2	2.465	2.465	2.465
C1 #2	-0.623	-0.623	-0.623
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qu (csm) #2	167.829	167.829	167.829
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$$\text{qp (cfs)} = \text{qu (csm)} * \text{Area (sq.mi.)} * Q(\text{in.}) * (\text{Pond \& Swamp Adj.})$$

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Developed Conditions  
Soap Factory Only

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qu (csm) #1	731.328	731.328	731.328
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	731.328	731.328	731.328
* qu (csm)	731	731	731

\* 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.

$$\log(\text{qu}) = C0 + (C1 * \log(\text{Tc})) + (C2 * (\log(\text{Tc}))^2)$$
$$\text{qp (cfs)} = \text{qu(csm)} * \text{Area(sq.mi.)} * \text{Q(in.)} * (\text{Pond \& Swamp Adj.})$$