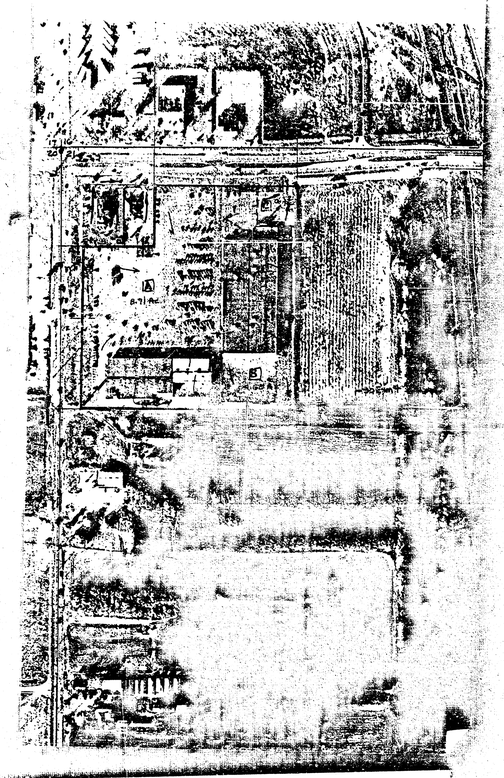


SOUTHGLEN ADD'N. – IN N.W. ¼ SEC. 21-28-1E

DRAINAGE EVALUATION

BASIC DATA –

From S.C.S., Hydrologic Soil Groups, Generally Are:
Basins "C, D, F, G & H" = "C" Soils
Basins "A, B & E" = "B" Soils

Design Storm Frequency –
Residential – 2 years
Commercial – 5 years
Channels & Pond – 100 Year

Street Classifications –
Local, in Residential Areas
Collector, Main Entrance Drive
Between Commercial Lots

Drainage Area: ≤ 320 Ac. ∴ Use Rational Formula

Rational "C" Factors To Be Used:

Land Use	2 Yr. Storm "B" Soil	2 Yr. Storm "C" Soil	5 Yr. Storm "B" Soil	5 Yr. Storm "C" Soil	100 Yr. Storm "B" Soils	100 Yr. Storm "C" Soils
½ Ac. Residential	0.52	0.55	–	–	0.67	0.73
Commercial	–	–	0.69	0.69	0.80	0.80
Recreation	0.18	0.26	–	–	0.39	0.53

For T_c, Basin "A" has the longest travel path
L = 1050'; H = 5'; Ave. Slope = 0.5%
Est'd Velocity Between 1.6 fps & 2.0 fps
∴ Travel Time ≅ 9.5 to 11 min.

⇒ Use Min. T_c = 15 minutes

⇒ Then, I_2 = 3.83"/hr.
⇒ I_5 = 4.56"/hr.
⇒ I_{100} = 7.37"/hr.

(1)

Within Basin "A" – All Residential –
Area = 8.07 Ac.; Soil "B"
"C" = 0.52
I_2 = 3.83"/hr ; I_{100} = 7.37"/hr

Total Basin "A" Discharge = $Q_2 = CI_2A$
$Q_2 = 0.52 \times 3.83 \times 8.07$
⇒ Q_2 = 16.03 cfs

Then, In Basin "A", Sub-Basin Unit Discharge (Q_2)
= 16.03 cfs / 8.07 Ac = 1.986 cfs/Ac.

Within Basin "A", the following Sub-Basin Areas & Discharges, As Follows:

Sub-Basin "A"	Area	Discharge (Q_2)
I	1.72 Ac.	3.41 cfs
II	1.30 Ac.	2.58 cfs
III	0.99 Ac.	1.97 cfs
IV	1.05 Ac.	2.09 cfs
V	1.29 Ac.	2.56 cfs
VI	0.82 Ac.	1.63 cfs
VII	0.90 Ac.	1.79 cfs
⇒ Total Basin "A"	= 8.07 Ac	& 16.03 cfs (Q_2)
⇒		30.85 cfs (Q_{100})

Within Basin "B" – All Residential –
Area = 4.47 Ac.; C = 0.52; Soil "B"
I_2 = 3.83"/hr; I_{100} = 7.37"/hr
& Q_2 Unit Discharge = 1.986 cfs/Ac.

Sub-Basin "B"	Area	Discharge (Q_2)
IX	1.66 Ac.	3.30 cfs
X	1.51 Ac.	3.00 cfs
XI	1.30 Ac.	2.58 cfs
⇒ Total Basin "B"	4.47 Ac.	8.88 cfs (Q_2)
⇒		17.15 cfs (Q_{100})

(2)

Within Basin "C" – Part Residential & Part Commercial
In Sub-Basin XII – Soil "C"
Commercial Lot – A = 1.75 Ac.
C = 0.69
I_5 = 4.56"/hr; I_{100} = 7.37"/hr
$Q_5 = CIA = 0.69 \times 4.56 \times 1.75$
⇒ Q_5 = 5.51 cfs

$Q_{100} = CIA = 0.69 \times 7.37 \times 1.75$
⇒ Q_{100} = 8.90 cfs

Residential Area – A = 2.69 Ac.
C = 0.55 & 0.73
I_2 = 3.83"/hr
$Q_2 = CIA = 0.55 \times 3.83 \times 2.69$
⇒ Q_2 = 5.67 cfs

$Q_{100} = CIA = 0.73 \times 7.37 \times 2.67$
⇒ Q_{100} = 13.18 cfs

In Sub-Basin XIII – Soil "C"
Commercial Lot – A = 1.68 Ac.
C = 0.69
I_5 = 4.56"/hr
$Q_5 = CIA = 0.69 \times 4.56 \times 1.68$
⇒ Q_5 = 5.29 cfs

$Q_{100} = CIA = 0.69 \times 7.37 \times 1.68$
Q_{100} = 8.54 cfs

⇒ Residential Area – A = 1.35 Ac.
C = 0.55 & 0.73
I_2 = 3.83"/hr; I_{100} = 7.37"/hr
$Q_2 = CIA = 0.55 \times 3.83 \times 1.35$
⇒ Q_2 = 4.84

(3)

Sub-Basin XIII Cont'd

$Q_{100} = 0.73 \times 7.37 \times 1.35$
⇒ Q_{100} = 7.26 cfs

Within Basin "D" – Soil "C"
Sub-Basin XIV
Commercial Lot – A = 2.67 Ac.
C = 0.69
I_5 = 4.56"/hr; I_{100} = 7.37"/hr.

$Q_5 = CIA = 0.69 \times 4.56 \times 2.67$
⇒ Q_5 = 8.40 cfs

$Q_{100} = CIA = 0.69 \times 7.37 \times 2.67$
⇒ Q_{100} = 13.58 cfs

Residential Area = A = 0.83 Ac.
C = 0.55 ; 0.73
I_2 = 3.83"/hr; I_{100} = 7.37"/hr

$Q_2 = CIA = 0.55 \times 3.83 \times 0.83$
⇒ Q_2 = 1.75 cfs

$Q_{100} = CIA = 0.73 \times 7.37 \times 0.83$
⇒ Q_{100} = 4.47 cfs

Recreation Area – 1.10 Ac.
C = 0.26 ; 0.53
I_2 = 3.83"/hr; I_{100} = 7.37"/hr

$Q_2 = CIA = 0.26 \times 3.83 \times 1.10$
⇒ Q_2 = 1.10 cfs

$Q_{100} = CIA = 0.53 \times 7.37 \times 1.10$
⇒ Q_{100} = 4.30 cfs

(4)

Within Basin "E" – Soil "B" – Residential Area
A = 2.82 Ac.
C = 0.52 ; 0.67
I_2 = 3.83"/hr; I_{100} = 7.37"/hr

$Q_2 = CIA = 0.52 \times 3.83 \times 2.82$
⇒ Q_2 = 5.62 cfs

$Q_{100} = CIA = 0.67 \times 7.37 \times 2.82$
⇒ Q_{100} = 13.92 cfs

Within Basin "F" – Residential & Recreational Areas – Soil B = 20%
C = 80%

Residential Area – A = 0.80 Ac.
$C_2 = \frac{(20 \times 0.52) + (80 \times 0.55)}{100} = 0.54$; C_{100} = .72 ∴

I_2 = 3.83"/hr ; I_{100} = 7.37"/hr

$Q_2 = CIA = 0.54 \times 3.83 \times 0.80$
⇒ Q_2 = 1.78 cfs

$Q_{100} = CIA = .72 \times 7.37 \times 0.80$
⇒ Q_{100} = 4.56 cfs

Recreational Area – 1.41 Acres
$C_2 = (20 \times .018) + (80 \times 0.26)/100 = 0.24$
$C_{100} = (20 \times 0.39) + (80 \times 0.53)/100 = 0.50$
I_2 = 3.83"/hr
I_{100} = 7.37"/hr

$Q_2 = CIA = 0.24 \times 3.83 \times 1.41$
⇒ Q_2 = 1.30 cfs
$Q_{100} = CIA = 0.50 \times 7.37 \times 1.41$
⇒ Q_{100} = 5.20 cfs

(5)

Within Basin "G" – Recreational & Residential Areas
Soil B = 20% ; Soil C = 80%

Residential Area – A = 1.10 Ac.

$C_2 = (20 \times 0.52) + (80 \times 0.55)/100 = 0.54$
$C_{100} = (20 \times 0.67) + (80 \times 0.73)/100 = 0.72$
I_2 = 3.83"/hr ; I_{100} = 7.37"/hr

$Q_2 = CIA = 0.54 \times 3.83 \times 1.10$
⇒ Q_2 = 2.28 cfs

$Q_{100} = CIA = 0.72 \times 7.37 \times 1.10$
⇒ Q_{100} = 5.84 cfs

Recreational Area – A = 9.61 Ac.
$C_2 = (20 \times 0.18) + (80 \times .26)/100 = 0.24$
$C_{100} = (20 \times 0.39) + (80 \times .53)/100 = 0.50$
I_2 = 3.83"/hr ; I_{100} = 7.37"/hr

$Q_2 = CIA = 0.24 \times 3.83 \times 9.61$
⇒ Q_2 = 8.83 cfs

$Q_{100} = CIA = 0.50 \times 7.37 \times 9.61$
⇒ Q_{100} = 35.41 cfs

SEE BASIN "H" ATTACHED

Off Site (K-Mart & FPS Add'ns) Drainage Basin – Contributes to W. End of existing 50' Drainage Esmt., running E-W thru "Southglen"

From P.F.C.'s Evaluation, dated 8-19-81
T_c = 11 min.; D.A. = 13.4 Ac.; "C" = 0.9; T_{100} = 10.14"/hr
Modify the above, to conform to latest City of Wichita Policy, & Re-Compute Q_{100}, as follows:

(6)

Basin "H" – All Residential – Soil "B"
A = 1.85 Ac ; C = 0.52 ; I_2 = 3.83"/hr & I_{100} = 7.37"/hr
A_{w} = 20.67

$Q_2 = CIA = 0.52 \times 3.83 \times 1.85$
⇒ Q_2 = 3.68 cfs

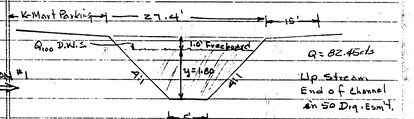
$Q_{100} = CIA = 0.67 \times 7.37 \times 1.85$
⇒ Q_{100} = 9.14 cfs

(6-a)

Off-Site – Contributing D.A.'s as follows:
Lot 1, K-Mart Add., except the E. 380' = 6.83 Ac.; E. 380' of Lot 1, K-Mart Add. = 7.0 Ac.; All of F.P.S. Add. = 5.6 Ac.
T_c (min.) = 15 minutes; D.A. = 12.43 Ac.; I_{100} = 7.37"/hr
Roofs = 20% of Area; w/ C_{100} = 0.93
Drives, Parking Lots, Walks = 80% of Area, w/ C_{100} = 0.89

Weighted $C_{100} = (20 \times 0.93) + (80 \times 0.89)/100$
C_{100} = .90

Then, $Q_{100} = CIA = 0.90 \times 7.37 \times 12.43$ Ac.
Q_{100} = 82.45 cfs at W.P. Southglen



From Mannings $Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$
w/ S = 0.5% ; "n" = 0.030 & Q_{100} = 82.45 cfs

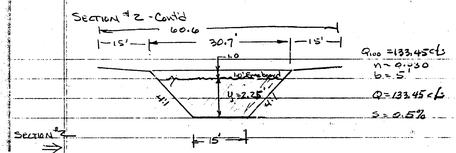
Then Normal Depth of flow (y) = 1.80' (open channel)
A = 21.99 sf ; P = 19.856' ; R_h = 1.1075 ; V = 3.75 fps

At Downstream End of 50' Dia. Channel, (Being also up stream end of 30' Dia. Channel at S.E. Cor. of K-Mart Add'n.), an additional 7.0 Ac. of contributing D.A., + ½ of Basin "H" (9.26/2) = 4.63 cfs
Then, Q_{100} = CIA = 0.90 × 7.37 × 19.43
SECTION #2 ⇒ Q_{100} = 128.88 cfs + 4.57 = 133.45 cfs

y_n = 2.25'
A = 31.42 sf ; P = 23.57' ; R_h = 1.34 ; V = 4.25 fps

(7)

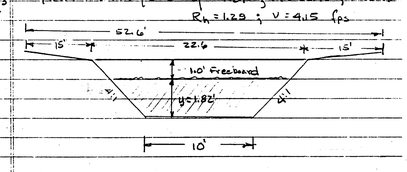
Section #2 – Contd



From Mannings ; y = 2.25' ; A = 31.42 sf ; P = 23.57'
R_h = 1.34 ; V = 4.25 fps

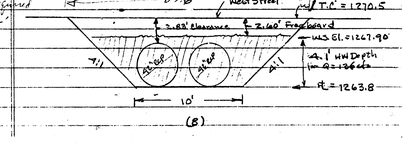
At Upstream Side of 1st Street (W) Crossing
Section #3 – Existing Channel, w/ 10' bottom & 4:1 S/P
a) A_w = Open channel Flow, w/ Q_{100} = 133.45 + ¼"ø (229 cfs)
∴ Q = 135.74 ; b = 10' ; s = 0.5% ; "n" = 0.030

From Mannings ; y = 1.87' ; A = 32.75 sf ; P = 25.44'
R_h = 1.29 ; V = 4.15 fps



(8)

(c) As Culvert Flow – Under Street (West) Crossing
w/ Q_{100} = 135.74 cfs ; 2-42" RCP's, each @ 68 cfs
@ HW depth = 3.95'



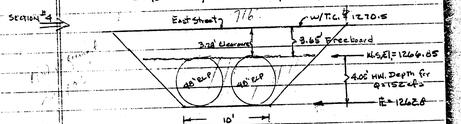
SECTION "4 - AT UPSTREAM SIDE of STREET (cont'd)

ROUTING

A2 Section Flow = Q_{100} = 135.74 + Q_{100} from Sub-basins XII (Residential 13.18cfs & Commercial 8.7 cfs)
+ Q_{100} from E-W Basin "H" (2.28 cfs)
Then, Total Q_{100} at Section "4 =

	135.74
	13.18
	8.70
	2.28
	160.10 cfs

At Section "4 Q_{100} = 160.10 cfs
2-48" R.C.P.S; each at 76cfs; HW depth = 4.05'



SECTION "5 - AT DISCHARGE INTO RIVERSIDE DRG DISTRICT CHANNEL

A2 Section Flow = Q_{100} = 160.10 cfs + Q_{100} from Sub-Basin XIII (Res. 7.26cfs; Commercial 8.54cfs)
+ BASIN D (4.47cfs; 4.30 cfs; 13.58cfs) + BASIN "A" (30.85cfs)
+ BASIN "E" (13.92 cfs) + BASIN "F" (9.56cfs; 5.20cfs)

Q_{100} = 160.10 + 7.26 + 8.54 + 4.47 + 4.30 + 13.58 + 30.85 + 13.92 + 9.56 + 5.20

⇒ Section "5, Q_{100} = 252.78 cfs

From Mannings: y = 2.55'
A = 51.50 sf
P = 21.03'
R_h = 1.66
V = 4.91 fps

(9)

Min R/W Req'd (68.4') 120'
90'
15' 30' 15'
1' Freeboard
9'
4:1 4:1
4=2.55'
10'

SECTION "5

DRG CHANNEL IN BASIN "F"

Q_{100} = BASIN "A" + BASIN "E" + BASIN "F"
= 30.85 + 13.92 + 9.76
⇒ Q_{100} = 54.53

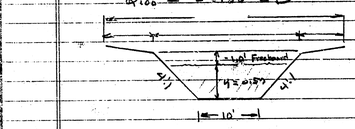
52.6'
15' 27.6' 15'
1' Freeboard
4'-1.02'
4:1 4:1
10'

y = 1.02'
A = 14.29 sf
P = 18.38'
R_h = 0.78
V = 3.82 fps

(10)

DRAINAGE CHANNEL IN BASIN "D"

Q_{100} = Sub-Basin XIV in Basin "D"
= 13.58 + 4.47 + 4.30
Q_{100} = 22.35 cfs



y = 0.50
A = 5.97
P = 14.10
R_h = 0.42
V = 3.75

DETENTION POND -
Q_{100} = BASIN "B" + BASIN C
= 17.13 cfs + (5.84 + 35.4)
⇒ Q_{100} = 58.37 cfs

TOTAL D.A. = 9.61 Ac + 1.10 Ac + 4.47 Ac
TOTAL D.A. = 15.18 Ac

POND Volume ≈ 9.5 x 1.5 Ac (Surface)
= 14.25 Ac Ft.

⇒ I_{100} (24 hr Storm, w/ AMC II = 7.9"
7.9" = 0.666'
15.18 Ac
10.02 Ac Ft. of TOTAL RAINFALL Volume

(11)

If Runoff were 100%,
Detention Volume = 1.42 x Runoff

⇒ AVAILABLE STORAGE IS MORE THAN ADEQUATE WITHOUT DISCHARGE

Out-let Pipe to Riverside Drg Dist. channel to be capable of discharging within 4 days

A culvert pipe capable of discharging 1.26 cfs would accomplish this end.

A more analytical approach will be made.

(12)

12-16-86 FINAL PLAT - CONTINUED

RE-EVALUATION OF DRAINAGE REQUIREMENTS ASSOCIATED WITH EXISTING 50' DRAINAGE EASEMENT - INVESTIGATE FEASABILITY OF REDUCTION OF EASEMENT WIDTH

From the data available, it appears that the 50' wide Drainage Easement (Recorded at Film 50= Pg 1015) was established to accomodate the peak discharges for the 100 year event, from both "K-Mart Plaza South" and F.P.S. First Addition.

The total area of F.P.S. First Add'n, is approximately 5.61 Acs. Hydrology computations for F.P.S. First Add'n by P.E.C., used a value of 3.47 Acres contributing from F.P.S. toward the West end of the 50' easement in question. Presumably, the difference in drainage area is to be directed toward Broadway.

P.E.C's computations assumed DA = 3.47 Ac.; Rational "C" = 0.90, resulting in C = 35 cfs. Therefore, the assumed rainfall intensity was 8"/hr.

Modify the above findings, To conform to the latest City of Wichita Design Criteria, as follows:

a/ Soil is C_a, Hydrologic Soil Group "B"
b/ 100yr Storm for channel evaluation
c/ Rational "C" Factor = 0.80 (100yr Commercial)
d/ Min. T_c = 15 min.
e/ I_{100} = 7.37 "/hr
f/ D.A. = 3.47 Ac.

⇒ ∴ Q_{100} (F.P.S. First Add'n) = 0.80 x 7.37 x 3.47 = 20.5 cfs

D

The only other contributing drainage area upstream of the 50' wide drainage easement, here being evaluated, is the K-Mart Plaza South Addition.

The total area of this subdivision is approx. 13.84 Ac.±. An area 150' x 150', near the N.E. Corner of the plat, is directed into the storm sewers in 47th St. So. (Sub-basin "C"). The remaining 13.31 Ac.± is served by a system of storm sewers that discharges at the S.E. Corner of the plat, into an existing drainage channel, within a 90' wide drainage easement.

The enclosed xerox of the aerial photo of this drainage area, is marked in red outlining the 3 drainage sub-basins.

Basin "A" includes all the paved parking and drive areas in front of the two commercial buildings, together with the adjacent ½ of the building roof areas.

Basin "A" contains 8.71 Acres. The storm water runoff concentrates to several grated drop inlets in the parking lot. The grading of the parking lot, is such that water in excess of inlet capacity and/or the capacity of the connected storm sewers will pond and be temporarily detained in the parking lots. The overflow cut-let elevations, from Basin "A" to Basin "B", are approximately 24" above the grate elevation of the drop inlets, and so it is relatively safe to say that virtually all runoff in excess of the inlet and storm sewer capacity will be detained within Basin "A".

(2)

Sub-Basin "B" (4.60 Ac.±) encompasses the rear ½ of the building roof areas, together with the adjacent paved areas on the South and East side of the buildings.

Paved areas are sloped to the perimeter curb and gutters, which are constructed along the East and South property lines. There are a total of 5 or 6 standard curb inlets along these two c & g sections. The excess storm water not intercepted by the curb inlets, is directed to a paved (concrete) flume, at the S.E. Corner of the property. The flume discharges directly into the (80' R/W) drainage channel, near the outlet of the storm sewer. Both of these discharges flow East toward the Riverside Ditch, in an existing channel, constructed within a 90' Drg. Esm't.

Then, evaluate the capability of the combined storm sewer and the outlet flume to convey the runoff from the 100yr event, independently of channel capacity planned in the 50' Drainage Easement.

(3)

SUB-BASIN A - 100yr event -
Contribution will be only the Q_5 discharge as conveyed thru the system of storm water sewers, the excess being detained on the parking lot.

Basic Data - T_c = 15 minutes; A = 8.71 Ac.
I_5 = 4.56"/hr (I_{100} - I retained)
Roofs = 20% of Area, w/ C_{100} = 0.93
Drives, Parking Lots, Walks = 80% of Area, w/ C_{100} = 0.89

Weighted C_{100} = $\frac{(20 \times 0.93) + (80 \times 0.89)}{100}$ = 0.90

Then Q_5 = C I A = 0.90 x 4.56 x 8.71
⇒ Q_5 = 35.75 cfs [SUB-BASIN "A"]

SUB-BASIN "B" - 100yr Event -

Basic Data - T_c = 15 min; A = 4.60 Ac±
I_{100} = 7.37"/hr; Weighted C_{100} = 0.90

Q_{100} = 0.90 x 7.37 x 4.60
⇒ Q_{100} = 30.51 cfs [SUB-BASIN "B"]

TOTAL CONTRIBUTION - 100yr event - K-Mart Plaza

SUB-BASIN "A" =	35.75 cfs	(Thru storm sewer)
SUB-BASIN "B" =	30.51 cfs	(In Sewer & Overland)
SUB-BASIN "C" =	0	(Toward 47th St.)
	66.26 cfs	

⇒ NOTE: This discharge is partly in storm sewer & the excess overland, outletting @ Flume

(4)

ESTIMATE STORM SEWER CAPACITY

The downstream segment of existing storm sewer is 45" x 29" HECP; w/ gradient = 0.4% and "n" = 0.012, the Mannings formula would indicate the maximum flow to be as follows: (Non-Pressure Conditions)
For 45" x 29" HECP
A = 7.4 sq.ft.; R_h = 0.736 ft; $R_h^{2/3}$ = 0.82

$Q = \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2} = \frac{1.486}{0.012} \times 7.4 \times 0.82 \times 0.00325$

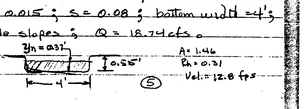
⇒ Q = 47.52 cfs

Then, of the total Q_{100} (66.26 cfs) that is directed to the S.E. Corner of K-Mart Basins, 47.52 cfs can be conveyed in the storm sewer.

The excess 66.26 cfs Total
- 47.52 cfs sewer
18.74 cfs would have to discharge thru the concrete flume.

The concrete flume as constructed, has a width of 40' at its narrowest constriction, and a gradient of approximately 8%. The flume has concrete curbs, approx. 0.55' high, on each side.

Then from Mannings, as open channel flow, the normal flow depth for 18.74 cfs would be determined as follows:
n = 0.015; S = 0.08; bottom width = 4';
Vertical side slopes; Q = 18.74 cfs.

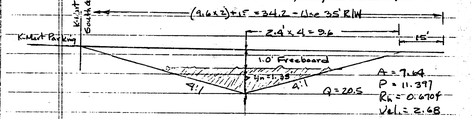


(5)

Consequently, it appears that the runoff from the K-Mart Plaza watershead can be reasonably accomodated by the combined capacity of the storm sewer and the concrete flume.

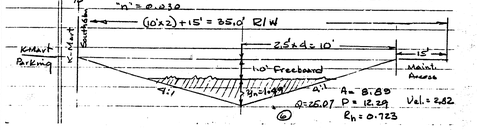
That being the case, the proposed drainage channel parallel with and adjacent to the East 380' of the South ℄ of K-Mart Plaza South, is needed only for the conveyance of runoff from F.P.S. First Add'n. (20.5 cfs from pg ④) together with that part of Sub-Basin "H" as outlined in previous drainage evaluation for SOUTHGLEN.

Therefore, at the East ℄ of F.P.S. First Add'n, the channel requirement is determined as follows:
⇒ Q_{100} = 20.5 cfs (from F.P.S. Add'n)
"n" = 0.030; S = 0.5%
"V" bottom channel, w/ side slopes = 4:1



At E. ℄ of K-Mart Plaza (Extended) the channel requirement is determined as follows:

⇒ Q_{100} = 20.5 + 4.57 (from South Stm = W. ½ Basin "H")
"n" = 0.030



⑥

Since it has been demonstrated that a 35' wide R/W is adequate, we would propose that the existing 50' Drainage Easement as recorded at Film 502, Pg 1015 be vacated and concurrently re-platted as a 35' Drainage Esm't. adjacent to the South line of K-Mart Plaza South.