MOEHRING & ASSOCIATES ——— CONSULTING ENGINEERS

PRELIMINARY DRAINAGE PLAN

FOR

BAXTER PLACE

December 1984

433 s. hydraulic ——— wichita, kansas 67211 ——— 316—263-8291

28 December 1984

Mr. Chris Breitenstein
Drainage Engineer
City of Wichita

Re: BAXTER PLACE
DRAINAGE STUDY

As a requirement of platting, we are submitting this preliminary drainage study for the purpose of evaluating existing drainage conditions, and to outline a drainage plan for the proposed multi-family development and the anticipated increases of storm water discharge from the site.

EXISTING CONDITIONS -

In general, the development site is located at the extreme upper end of a drainage basin which is South sloping, and has no well defined drainage channels. The total drainage area is 44.54 Ac. and is presently divided into 2 principal basins. The Westerly basin is approximately 19.19 ac., and the Easterly basin is approximately 26.07 Ac.

On the accompanying drawing (Exhitit "A") the outline of the total drainage basin is shown, as well as the outline of the two principal basins and their sub-basins. The Westerly basin is comprised of sub-basins I, VI, VII, VIII, IX and X. Sub-basins II, III, IV and V comprise the Easterly basin.

The runoff from the total drainage area is collected through road ditches, and a small system of storm sewers along Kellogg Drive, for discharge through an existing 5' x 3' RCBC under U.S. 54 highway.

Under present conditions, sub-basins I, II and III (17.73 Ac.) flow overland to the South, and are intercepted by the North ditch of Lewis St., and are collected by three existing cross-road culverts under Lewis. With available head water depths at the three culverts, (identified as A, B & C on Exhibit "A") the maximum discharge before overtopping Lewis St. is as follows:

Culv. A	=	8.2 cfs
Culv. B	=	15.0 cfs
Culv. C	=	13.5 cfs
Total	=	36.7 cfs

Due to the shallow section of the South ditch of Lewis (below Culv. A) the maximum flow that can be carried West to the East ditch of Ellson, before overflow goes South along the West side of Lot 49, is 4.8 cfs. It would be conservative to extimate that 50% or more of all flow in excess of 4.8 cfs, will flow overland to the South.

All of the runoff from sub-basin II and III discharges through culverts A & B, and then overland to the South, generally between Lots 44 and 45, and eventually on to the South between Lots 74 and 75.

The three (3) special inlets, constructed by the Highway Dept., along the North side of Kellogg Frontage Road have inlets on the back side to admit the overland flow from the North.

From some quick approximations, it is our feeling that the existing storm sewers in the Kellogg Frontage Road are capable of handling a run-off from a little better than the 2 year frequency storm under existing conditions of development in the drainage basin.

Correspondingly, the 5' x 3' RCBC under U.S. 54 has the capacity to discharge approximately 137 cfs under full-flow conditions and up to approximately 165 cfs with surcharge conditions up to the elevations of the flow line of the gutter inlet.

In order to evaluate the 5' x 3' RCBC under present conditions, we have determined the T_{ic} from the centroid of sub-basin II and to this added the channel flow velocities to the point of inlet of the 5' x 3' RCBC, arriving at a T_c of 23 minutes with a corresponding I_{100} of 7.60"/hr.

With an estimated weighted "C" = 0.4 for the entire drainage basin under present conditions of development, we have computed the Q_{100} to be 128 cfs. From this, it can be seen that the existing RCBC has the capacity to discharge the present Q_{100} plus approximately 30%.

DEVELOPMENT SITE - EXISTING CONTITIONS

The total area of the site will include 5.57 Ac. in sub-basin I, together with 7.26 Ac. in sub-basin II, less 1.14 Ac. near the Southeast corner and plus 0.6 Ac. near the Northeast corner of this sub-basin, for an equivalent total total drainage area of 12.29 acres.

The soil in this area is I_a and R_b, i.e. Hydrologic soil group "D". The average existing slope over the site = h/l = 9/613 = 1.47%.

The length (L) from the centroid of the D.A. to the North line of Lewis, is approximately 250 ft.

Rational "C" value for existing soil, cover and slope conditions is 0.30.

The $T_c = T_{ic}$ = time of overland flow from FAA formula

$$T_{ic} = 1.8\ (1.1 - \text{"C"})\ (L^{1/2})/S_a^{1/3}$$

$$= 1.8\ (1.1 - 0.30)\ (250^{1/2})/1.47^{1/3}$$

$$= 1.8 \times 0.8 \times 15.81/1.1355$$

$$T_c = 20 \text{ minutes}$$

From U.S.W.B. T.P. 40 - I_2 = 3.63"/hr. & I_{100} = 8.03"/hr.

With Rational Formula -

$Q_2 = CI_2A = 0.3 \times 3.63 \times 12.29 = 13.4$ cfs

$Q_{100} = CI_{100}A = 0.3 \times 8.03 \times 12.29 = 30$ cfs

Since this site does not lend itself to adequate detention, nor does it have access to well defined drainage channels, it becomes necessary to provide storm water sewer facilities adequate to convey the difference between existing and developed runoff, for peak conditions, to outlet at the 5' x 3' RCBC.

DEVELOPED CONDITONS -

Planned "R-6" development, has 200 D.U.'s, each with 448 sq.ft. of plan area = 200 x 448 = 2.057 Ac.

310 parking spaces @ 200 sq.ft./ea. = 1.423 Ac.

Paved Streets (w/o parking areas) -

a/	3740 L.F. interior streets x 24' wide	=	2.061 Ac.
b/	1 additional street area - 10' x 200'	=	0.046 Ac.
c/	Entrances to Public R/W - 160' x 24'	=	0.088 Ac.
d/	Conc. walks, 6200 L.F. x 4'	=	0.569 Ac.
e/	200 patio's @ 400 sq.ft./ea.	=	0.918 Ac.
	Total Imperv. Area	=	7.162 Ac.

% Impervious Area - 7.162 Ac./11.28 Ac. = 63.5% Impervious and 36.5% Pervious

For determination of Rational "C" factor,

Use 0.90 for impervious areas & 0.30 for pervious areas

Then, 11.28 Ac. x 63.5% x 0.90 = 644.65
11.28 Ac. x 36.5% x 0.30 = 123.52
768.17

Then, Weight "C" = 768.17/11.28

"C" = 68

TIME OF CONCENTRATION - DEVELOPED CONDITIONS

For the time of initial concentration, use FAA Formula. For the developed site, the longest flow pattern is in the Easterly sub-basin, and is shown on the site Development Plan.

The length of overland flow = 125'; H = 1.5'; C = 0.3; S_a = 1.5/120 = 1.25%

Then $T_{ic} = 1.8\ (1.1 - 0.3)\ (125)^{1/2}/1.25^{1/3}$

T_{ic} = 16.0997/1.0772 = 15 minutes

The contributing D.A. above the point where overland flow enters the street drainage pattern, is approximately 1.45 acres; weighted "C' - 0.68, and for T_c = 15 minutes, I_{100} = 8.98"/hr.

Then, Q_{100} = 0.68 x 8.98 x 1.45 = 9 cfs

This would represent the peak discharge flowing down the inverted crown asphalt pavement.

Then, determine flow velocity in the street section and the corresponding travel time to the point of inlet into the proposed storm sewer near the South of the development site.

The minimum x-slope gradient = 3%, the presently planned longitudinal gradient = 0.67%; "n" = 0.020

From Mannings, and with Q = 9 cfs, velocity of flow = 2.0 ft./sec.

The length of flow to the beginning of proposed storm sewer for off site conveyance = 470 L.F.

Then T_c = 15 min. + 4 min. = 19 minutes

Then, Peak Discharge from developed site contributing to the storm sewer is computed as follows-

"C" = 0.68; T_c = 19 min.; I_{100} = 8.19"/hr.; D.A. for Interior Basin = 9.15 Ac.

$Q = CI_{100}A$ = 0.68 x 8.19 x 9.15

Q_{100} = 51 cfs

The corresponding Q_{100} for that part of the development site, lying outside of the interior basin, would be calculated for the remaining site area, as follows:

Perim. D.A. = Initial Area - Interior Area

Then, Perim. D.A. = 12.25 Ac. - 9.15 Ac. = 3.1 Ac.

Then, $Q_{100} = CI_{100}A$ = 0.68 x 8.19 x 3.1 = 17 cfs

Developed - Total Q_{100} = 51 + 17 = 68 cfs

Then, Developed, less Existing Q_{100} = the peak discharge rate that should be conveyed in the proposed off-site storm water sewer, = 68 cfs - 30 cfs = 38 cfs

Using the Amer. Conc. Pipe Assoc. "Design Data" for Flow Capacity of Sewers, the following -

From field survey and preliminary profile for proposed off-site, the available gradient is ± 0.8%

Then, $Q/S^{1/2} = 38/(0.008)^{1/2} = 425$

From the tabulations, a 30" RCP @ 0.8% gradient, will accommodate the design difference between the Existing and Developed 100 year discharge from the site.

Our preliminary storm sewer gradient, might vary up or down, depending on final determination of future curb and gutter elevations and required clearances between the bottom of the gutter section and the top of the RCP barrel.

The approximate quantities for the proposed storm water sewer are tabulated on the preliminary profile for the proposed off-site sewer.

In conclusion, we have obtained verbal consent for the required 20' storm sewer easement adjacent to the West property line of Lots 47 and 74. The executed Drainage Easement should be submitted shortly after the holidays.

Respectfully submitted,

MOEHRING & ASSOCIATES
CONSULTING ENGINEERS

Don C. Moehring II

DCM:om