



## **Remington Place 2<sup>nd</sup>** **Wichita, Sedgwick County, Kansas**

9/16/02

Remington Place 2<sup>nd</sup> is a development in northeast Wichita containing both commercial and residential areas. It consists of a 2.6 acre area for commercial use and 14 residential lots. Development plans include commercial office buildings, parking, open space, patio homes, three landscaped ponds, and utilities. The drainage plan and supporting calculations for Remington Place 2<sup>nd</sup> are presented herein.

### **Hydrology**

The proposed plat lies in the E ½, NW ¼, Section 9, T27S, R2E of the 6<sup>th</sup> P.M. The soils on-site consist of Goessel silty clay and Irwin silty clay loam. These soils are classified in hydrologic group D. The existing landscape is vacant posture with trees on all sides and across the middle of the property. The plat generally drains to the northeast corner of the plat and then to a Four Mile Creek tributary.

For runoff calculations, the plat was divided into 3 major basins, each with its own discharge. Additional runoff on the site will come from the south via a future storm sewer and street flow from Remington Place Addition. The offsite runoff combined with Basin 1 runoff will discharge to Pond No. 1. Pond No. 1 will discharge to Pond No. 2, which also accepts runoff from Basin 2. Pond No. 2 will then discharge to Pond No. 3, which also accepts runoff from Basin 3. The net effect of the three ponds is to reduce the plat runoff from 74.6 cfs for existing conditions to 64.0 cfs for proposed conditions.

Using the Army Corp of Engineer's program HEC-1, all systems were modeled with runoff based on the Rational Method. In the model, minor basins 1B, 1C, 1D, and 1E were combined with the offsite basin due to the small size of the basins and to the fact that the runoff from the minor basins joins the offsite runoff before entering Pond No. 1. The minimum time of concentration was assumed for all basins, so the basins could be combined with negligible lag time. The ponds were included to determine water elevations in the 100-year design storm and to determine the outfall from the ponds via weirs.

Runoff coefficients were estimated based on existing land use and the tables presented in the Design Aids section. A map showing the basin boundaries, drainage calculations, and HEC-1 model are included. The analysis made is based on the available site data which includes the following: 1"=100' topographic map with 2' contours of the site and adjacent areas, USGS topographic map, Sedgwick County Soil Survey Map, and references noted herein.

### **Storm Sewer Design**

For the storm sewer hydrologic analysis, the Rational Method was again used. Runoff coefficients were estimated using the charts in the design aids section of this report. For this development, a uniform assumption of the *minimum time of concentration* of 15 minutes was deemed appropriate. Travel time for flow through defined channels, pipes, etc, for these basins was estimated on the basis of Manning's Equation.

In the hydraulic analysis, the storm sewers are designed for the minor storm, with major storm overflows to be routed through easements and rights-of-way to an *appropriate outlet*. The minor storm has a recurrence interval of two years. The major storm evaluated has a recurrence interval of one hundred years. To simplify this analysis, the time of concentration is identical for both the major and the minor storms.

For each inlet, street flooding and inlet capacity were checked for the minor storm. Conveyance in the street is based on the Modified Manning's Equation, as expressed in the Design of Urban Highway Drainage-The State of the Art, Equation (5-1), page 5-9. It has been assumed that  $T_c$  for street flow is equal to  $T_c$  for pipe flow. This is a simplifying, but conservative, assumption, since pipe flow velocities generally exceed street flow velocities.

Inlet capacities were determined by the methods described in Drainage of Highway Pavements, Hydraulic Engineering Circular #12, using Chart #12 as found in the Design Aids section. City of Wichita Type 1A inlets and 3/8 inch per foot cross slopes have been assumed. Streets have been assumed to have 6-5/8 inch standard curb, unless otherwise noted.

The storm sewer for this plat is designed to tie into the future storm sewer from Remington Place Addition and Cranbrook Street. Hydraulic computation for the pipe system was performed using PEC's STORM computer program. This program uses Manning's Equation to calculate friction losses for pipes flowing full. Minor losses are computed by momentum principles at each structure. All pipe area is assumed to be reinforced concrete with a Manning's "n" of 0.013. It is desirable to keep the hydraulic grade line at least one foot below the top of curb for the minor storm. The STORM analysis for the combined storm sewer is

included in this report. Note that the inlet at node 130 and, subsequently, the pipe system connecting node 130 to Pond 1 was sized to handle flows from the 100-year storm in order to greatly reduce overflow between lots 11 and 12 during storms greater than the 2-year storm. (The STORM analysis showing the sizing of inlet 130 and the analysis showing the actual 2-year storm flow rates are both included.)

### **Design Aids**

This section includes material used to assist in designing the drainage system. A 1"=50' scale drainage plan map is enclosed in the pocket.

### **References**

Design of Urban Highway Drainage – The State of the Art, by Reitz & Jens, Inc., April 1980.

Drainage of Highway Pavements, Hydraulic Engineering Circular #12, by Tye Engineering, Inc., March 1984.

Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation, City of Wichita, Kansas, 1985.

Soil Survey of Sedgwick County, Kansas, US Department of Agriculture, Soil Conservation Service, 1979.



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Project REMINGTON PLACE 2<sup>ND</sup>  
Item HYDROLOGY

Date 9/12/02  
By \_\_\_\_\_

### EXISTING CONDITIONS

THE DISCHARGE FROM THIS SITE IS AN OVERLAND SWALE AT THE NORTHEAST CORNER OF THE PLAT. OFFSITE RUNOFF FROM REMINGTON PLACE ADDITION ALSO DISCHARGES AT THIS POINT.

FIND EXISTING RUNOFF USING THE RATIONAL METHOD,  $Q = CIA$

1. AREA = 15.5 AC

2. RUNOFF COEFFICIENTS,  $C$   
PERVIOUS OPEN SPACE  
SOIL GROUP "D", 1-4% SLOPE  
 $C_{100} = 0.65$

3. INTENSITY,  $i$

ASSUME MINIMUM TIME OF CONCENTRATION,  $T_c = 15 \text{ MIN}$   
 $i_{100} = 7.4 \text{ IN/HR}$

4.  $Q_{100} = C_{100} i_{100} A$

$$Q_{100} = 0.65 (7.4 \text{ IN/HR}) (15.5 \text{ AC}) = 74.6 \text{ CFS}$$

THEREFORE, THE EXISTING CONDITIONS RUNOFF FROM THIS SITE IS 74.6 CFS FOR THE 100-YR STORM. THE PROPOSED CONDITIONS RUNOFF FOR THIS PLAT SHOULD NOT EXCEED 74.6 CFS. PROPOSED CONDITIONS INCLUDE THE PROPOSED DEVELOPMENT OF THIS PLAT AND THE DEVELOPMENT OF THE AREA IN REMINGTON PLACE ADDITION WHOSE RUNOFF ENTERS THIS SITE.



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### PROPOSED CONDITIONS

#### FWD PROPOSED CONDITIONS RUNOFF

1. AREAS: 2.2 AC OFFICE  
1.9 AC POND RESERVE  
11.4 AC RESIDENTIAL

#### 2. RUNOFF COEFFICIENTS, C

2.2 AC OFFICE  
BUSINESS NEIGHBORHOOD AREAS  
 $C_{100} = 0.80$

1.9 AC POND RESERVE  
"D" 1-4% SLOPE  
 $C_{100} = 0.65$

11.4 AC RESIDENTIAL  
"4 AC RES SINGLE FAMILY "D"  
 $C_{100} = 0.76$

$$C_{100} = \frac{2.2 (0.80)}{15.5} + \frac{1.9 (0.65)}{15.5} + \frac{11.4 (0.76)}{15.5} = 0.75$$

#### 3. INTENSITY, i

$T_c = 15 \text{ MIN}$   
 $i_{100} = 7.4 \text{ IN/HR}$

#### 4. $Q_{100} = C_{100} i_{100} A$

$$Q_{100} = 0.75 (7.4 \text{ IN/HR}) (15.5 \text{ AC}) = 86.0 \text{ CFS}$$

THEREFORE NEED TO HAVE DETENTION TRENDS  
IN ORDER TO REDUCE RUNOFF FROM THE SITE  
SINCE  $86.0 \text{ CFS} > \text{EXISTING RUNOFF}$ .



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POUND #1

INFLOW

BASIN 1 AND OFFSITE FROM REMINGTON PLACE ADDITION

BASIN 1: 0.6 AC OFFICE,  $C_{100} = 0.80$   
4.3 AC 1/4 AC RES,  $C_{100} = 0.76$

$$C_{100} = 0.6/4.9 (0.80) + 4.3/4.9 (0.76) = 0.76$$

$$t_c = 15 \text{ MIN}, i_{100} = 7.4 \text{ IN/HR} \quad (* \text{ USE } t_c = 15 \text{ MIN FOR ALL BASINS})$$

$$Q_{100} = 0.76 (7.4 \text{ IN/HR}) (4.9 \text{ AC}) = \underline{27.6 \text{ CFS}}$$

OFFSITE: 6.8 AC 1/4 AC RES,  $C_{100} = 0.76$

$$i_{100} = 7.4 \text{ IN/HR}$$

$$Q_{100} = 0.76 (7.4 \text{ IN/HR}) (6.8 \text{ AC}) = \underline{38.2 \text{ CFS}}$$

$$\therefore \text{INFLOW} = 27.6 + 38.2 = 65.8 \text{ CFS}$$

$$\text{STATIC POOL ELEV} = 202'$$

SURFACE AREA

$$@ 202' = 0.20 \text{ AC}$$

$$@ 204' = 0.27 \text{ AC}$$

OUTFALL

ASSUME 10' BROAD-CRESTED WEIR @ 202'

FROM TEC-1 USING WEIR EQUATION  $Q = CLH^{1.5}$   
WITH  $C = 3.2$

$$DWS_{100} = 203'$$

$$Q_{100} = 64 \text{ CFS}$$



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POND #2

INFLOW

BASIN 2 AND POND 1 OUTFALL

BASIN 2: 2.1 AC OFFICE,  $C_{100} = 0.80$   
0.9 AC YARDS,  $C_{100} = 0.79$

$$C_{100} = 0.80$$

$$i_{100} = 7.4 \text{ in/hr}$$

$$Q_{100} = 0.80(7.4 \text{ in/hr})(3.0 \text{ AC}) = 17.8 \text{ CFS}$$

$$\text{POND 1} = 64 \text{ CFS}$$

$$\therefore \text{INFLOW} = 17.8 + 64 = 81.8 \text{ CFS}$$

$$\text{STATIC EL} = 199^{\circ}$$

SURFACE AREA

$$@ 199^{\circ} = 0.43 \text{ AC}$$

$$@ 202^{\circ} = 0.64 \text{ AC}$$

OUTFALL

$$5' \text{ WEIR @ } 199^{\circ}, C = 3.2$$

FROM HECL-1

$$DWS_{100} = 201^{\circ}$$

$$Q_{100} = 67 \text{ CFS}$$



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POND #3

INFLOW

BASIN 3 AND POND 2 OUTFALL

BASIN 3: 0.6 AC OFFICE,  $C_{100} = 0.80$   
0.2 AC 1/8 AC RES,  $C_{100} = 0.79$

$$C_{100} = 0.80$$

$$C_{100} = 7.4 \text{ in/hr}$$

$$Q_{100} = 0.80 (7.4 \text{ in/hr}) (0.8 \text{ AC}) = \underline{4.7 \text{ CFS}}$$

$$\text{POND 2} = \underline{6.7 \text{ CFS}}$$

$$\therefore \text{INFLOW} = 4.7 + 6.7 = 71.7 \text{ CFS}$$

$$\text{STATIC EL} = 195'$$

SURFACE AREA

$$\text{@ } 195' = 0.30 \text{ AC}$$

$$\text{@ } 198' = 0.50 \text{ AC}$$

OUTFALL

$$5' \text{ WEIR @ } 195', C = 3.2$$

FROM HEC-1

$$DWS_{100} = 197.5$$

$$Q_{100} = 6.4 \text{ CFS}$$

POND 3 OUTFALL IS THE RUNOFF LEAVING THE SITE.  
 $\therefore$  RUNOFF LEAVING THE SITE IS 6.4 CFS WHICH IS LESS  
THAN EXISTING RUNOFF FROM THE SITE EQUAL TO  
74.6 CFS.



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PROPOSED SWS

THE PROPOSED SWS FOR REMINGTON PLACE 2ND IS DESIGNED TO TIE INTO SWS FROM REMINGTON PLACE ADDITION ALONG CRANBROOK. THE STORM COMPUTER ANALYSIS OF THE ENTIRE SWS SYSTEM IS INCLUDED IN THIS REPORT.

1. HYDROLOGY, USING RATIONAL METHOD,  $Q = CIA$

DETERMINE AREAS, A

BASIN	NODE	AREA (AC)
1B	130	2.84
1C	150	0.61
1D	160	0.47
1E	170	0.31

DETERMINE RUNOFF COEFFICIENTS, C

BASIN	NODE	SOIL GROUP	LAND USE	$C_2$	$C_{100}$
1B	130	D	1/4 ACRES	0.50	0.76
1C	150	D	1/4 ACRES	0.50	0.76
1D	160	D	1/4 ACRES	0.50	0.76
1E	170	D	1/4 ACRES	0.50	0.76

DETERMINE INTENSITY,  $i$

ASSUME MINIMUM TIME OF CONCENTRATION,  $T_2 = 15 \text{ MIN}$   
 FOR ALL BASINS

$\therefore i_2 = 3.8 \text{ IN/HR}$   
 $i_{100} = 7.4 \text{ IN/HR}$



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DETERMINE FLOW RATES, (Q)

BASIN	NODE	C <sub>z</sub>	C <sub>100</sub>	C <sub>2</sub>	C <sub>1000</sub>	A (A)	Q <sub>2</sub> (CFS)	Q <sub>1000</sub> (CFS)
1B	130	0.50	0.76	3.8	7.4	2.84	5.4	16.0
1C	150	0.50	0.76	3.8	7.4	0.61	1.2	3.4
1D	160	0.50	0.76	3.8	7.4	0.47	0.9	2.6
1E	170	0.50	0.76	3.8	7.4	0.31	0.6	1.7

2. INLET SIZING / FLOOD ROUTING (2-4R)

BASIN	NODE	INLET	Q	Q <sub>max</sub> (5' INLET)	Q <sub>max</sub> (10' INLET)	Q <sub>100</sub>	Q <sub>24</sub>	USE
1B	130	SUMP	*16.0	11.0	22.0	16.0	—	L=10'
1C	150	R4826	1.2	N/A	N/A	1.2	—	1-2x2
1D	160	R4826	0.9	N/A	N/A	0.9	—	1-2x2
1E	170	R4826	0.6	N/A	N/A	0.6	—	1-2x2

\* NOTE THAT Q<sub>1000</sub> WAS USED TO SIZE THE INLET AT NODE 130. BH SIZING THE INLET TO INTERCEPT THE 100-YR STORM FLOW, OVERLAND FLOW BETWEEN LOTS 11 AND 12 FROM THE STREET SHOULD BE DRASTICALLY REDUCED IN STORMS EXCEEDING THE 2-YR STORM, THUS PREVENTING SEVERE WASHOUT.



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3. STREET FLOW

2-YR

NODE	Basin	Q <sub>2</sub>	DISTRIBUTION	STREET SLOPE	d	Q <sub>max</sub>	COMMENT
130	1B	5.4	100%(E)=5.4	0.5%	0.36'	0.55'	OK

100-YR

LOCATION	CONTRIBUTING AREA	Q <sub>100</sub>	Q <sub>pipe</sub>	Q <sub>street</sub>	STREET SLOPE	Q <sub>max</sub>	COMMENT
NODE 130	100% 1B	16.0	-	16.0	0.5%	29.2	OK

\* Q<sub>max</sub> IS THE MAX FLOW THE STREET CAN HANDLE W/O OVERLAPPING THE CURB

4. OVERFLOW

100-YR FLOW AT NODES 150, 160, AND 170 WILL FLOW TO CRANBROOK STREET AND BE CARRIED TO POND 1 VIA CRANBROOK STREET FLOW, WHICH IS DESIGNED WITH SUFFICIENT CAPACITY TO HANDLE THIS FLOW.