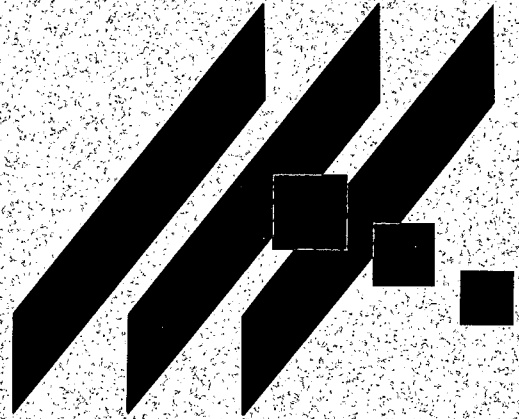


M K E C E N G I N E E R I N G C O N S U L T A N T S , I N C



DETENTION STUDY

FOR

**WEST EVANGELICAL FREE CHURCH**

APRIL 2003

# Detention Study for West Evangelical Free Church

Wichita, Kansas

## Location

The subject property lies in the Northeast Quarter of Sec. 18, Township 27 South, Range 1 West. The property is located South of 13<sup>th</sup> Street North, on the west side of Maize Road. The property is currently platted as Lot 1, Maranatha Addition.

## Soils

According to the NRCS (SCS) Sedgwick County Soil Survey, the drainage watershed soil is Vanoss silty loam. The Hydrological Soil Group (HSG) for this soil is "B" (see soil survey in Appendix A).

## Pre-developed Conditions

### *Current Development*

The property is currently developed as West Evangelical Free Church. This includes buildings, parking lots and some grassed areas. The total area of the property is approximately 5.5 acres.

### *Current Landform and Slope*

The slopes in the area range between 0.5-2%. Elevations vary from 1345 ft in the northeast corner to 1339 ft in the southwest corner.

### *Current Drainage Conditions*

No portion of the site is included in a regulatory floodplain. A copy of the effective FEMA map (FIRM Panel 125, Sedgwick County, June 3, 1986) is attached as Appendix B. A portion of the site in the southwest corner is included in a platted floodway easement as shown in Appendix C.

### *Current Runoff Characteristics*

Approximately 57 acres of developed area drains into an existing pond west of the subject property. The pond then discharges into a drainage reserve located along the south line of the property. This natural channel flows east into an existing double 7'x3' RCB under Maize Road. From here the channel turns south along Maize Road.

Runoff from the subject property drains from a high point in the northeast corner of the parking lot to the south and west. Runoff from the parking lot and existing buildings sheet flows into the drainage reserve along the south property line.

Two small Nyoplast inlets are located along the south edge of the pavement. These have limited capacity, and are likely bypassed in any substantial storm event. The large undeveloped area on the west side of the property drains to the southwest corner of the site. No substantial runoff from adjacent property enters the site.

The rational method was used to calculate runoff from the site. The site was divided into two areas – Area A includes the parking and buildings. Area B includes undeveloped area to the west. The runoff coefficient for Area A is 0.72. The runoff coefficient for Area B is 0.37. Times of concentration were assumed to be 15 minutes for Area A and 20 minutes for Area B. Table 1 shows the flow rates for 2, 5, 10, and 100-year events under current conditions.

**Table 1: Pre-development runoff.**

Sub-Watershed	2-Year (cfs)	5-Year (cfs)	10-Year (cfs)	100-Year (cfs)
A	9.5	11.2	12.9	18.1
B	2.6	3.1	3.6	5.1
Total Flow from Site	11.5	13.6	15.6	22.0

## **Post-Developed Condition**

### *Proposed Development*

The property will be improved by an expansion of the church. A new building will be constructed just west of the existing building. Also, additional paved parking areas will be constructed west of the existing parking facility.

### *Proposed Landform and Slope*

The proposed development will not affect the overall landform slope and basic drainage patterns on the property. Slopes and flow directions will remain the same as existing.

### *Proposed Runoff Characteristics*

The future runoff characteristics will remain similar to current patterns. Runoff from the site will increase due to the building expansion and additional paved parking area. Concrete curb and gutter will be installed along the south edge of the proposed pavement, and extend east along the existing pavement. Some existing pavement will be removed and replaced such that runoff will drain to the proposed curb, and then to the west. A 4' concrete flume will take the runoff from the southwest corner of the parking lot into the proposed detention area.

The proposed detention area will be a large area on the west side of the property. Depth will range from 0' to 3' at the outlet. Slopes will be 10:1 maximum and 1% minimum. The detention area will typically be dry and could be used as a playground area or athletic fields if desired. The outlet will be a 15"

pipe, which will drain into Reserve A, Arlington Place Addition, adjacent to south line of the property.

Runoff coefficients increased under post-developed conditions due to additional pavement and building area. The site has been divided into 3 sub-watersheds to represent the developed conditions. Area A represents the paved areas which will drain to the detention area. A runoff coefficient of 0.88 and time of concentration of 15 min. was used for this area. Area B represents the western portion of the property, part of which will be the detention area. A runoff coefficient of 0.37 and time of concentration of 20 min. was used for this area. Area C represents the buildings and portions of the paved area that will drain directly to the reserve. A runoff coefficient of 0.90 and time of concentration of 15 min. was used for this area. See Appendix D for the proposed conditions map. Table 2 shows the post-development flow rates for 2, 5, 10, and 100 year events. The "Pond Discharge" is the outflow from the proposed 15" pipe into the reserve adjacent to the site. The site was analyzed using Hydraflow Hydrographs software by Intellisolve. Detailed output is included in Appendix E. This output includes both existing and proposed conditions.

**Table 2: Post-development runoff.**

Sub-Watershed	2-Year (cfs)	5-Year (cfs)	10-Year (cfs)	100-Year (cfs)
A	5.6	6.7	7.6	10.8
B	2.3	2.8	3.2	4.5
C	7.0	8.3	9.5	13.4
Pond Inflow	7.4	8.7	10.0	14.1
Pond Discharge	1.3	1.2	0.8	0.0
Total From Site	7.0	8.3	9.5	13.4

As shown in Table 2 above, the detention facility will provide more than adequate storage for the developed conditions. Runoff from the site to Reserve A will be reduced for each of the storm events analyzed.

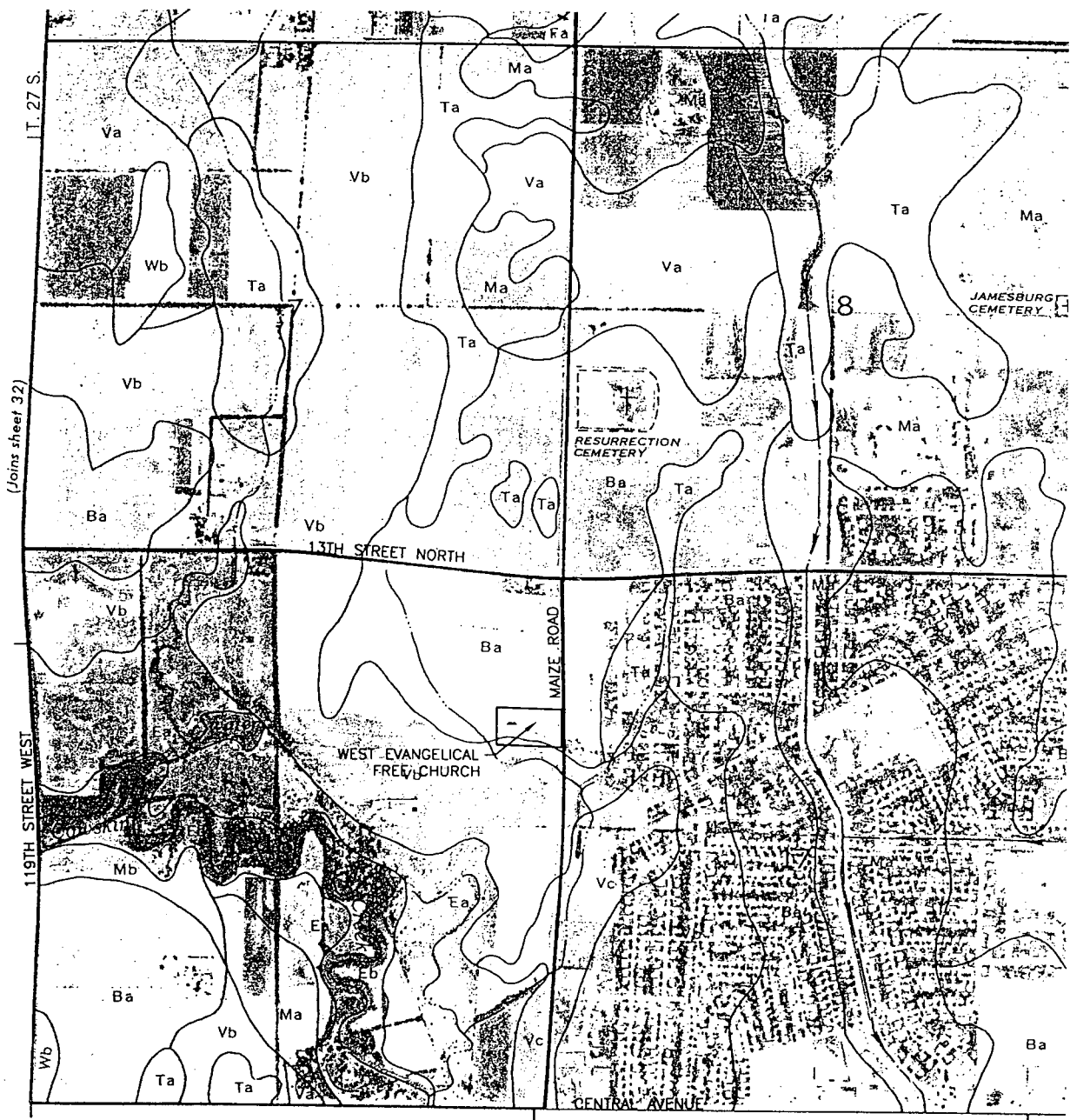
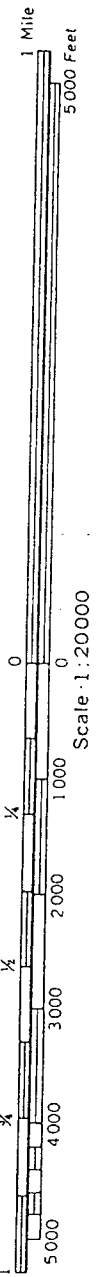
The tailwater conditions included in the software model were determined using the HEC-RAS software. The model was constructed based on surveyed cross sections of the Reserve.

## Summary

The site contains approximately 5.4 acres of land, which is currently developed as West Evangelical Free Church. The proposed addition includes another building and additional paved parking. A detention facility will be provided on the west side of the property. A large portion of the existing parking area and all of the proposed parking areas will be graded to drain into the detention facility. Runoff from the buildings and remaining parking area will continue to drain into Reserve A, Arlington Place Addition. The detention facility will drain into Reserve

A through a 15" pipe. The detention volume provided will be more than adequate to reduce the discharge from the site to less than the existing flow.

**APPENDIX A  
SOIL SURVEY**



**MKEC**  
ENGINEERING  
CONSULTANTS  
411 N. WEBB ROAD  
WICHITA, KS. 67206  
316 - 684 - 9600

**WEST EVANGELICAL FREE CHURCH**

PROJECT NAME

**SOIL SURVEY OF  
SEDGWICK COUNTY, KANSAS**

SHEET TITLE

**KLA**  
DESIGN BY:

**KLA**  
DRAWN BY:

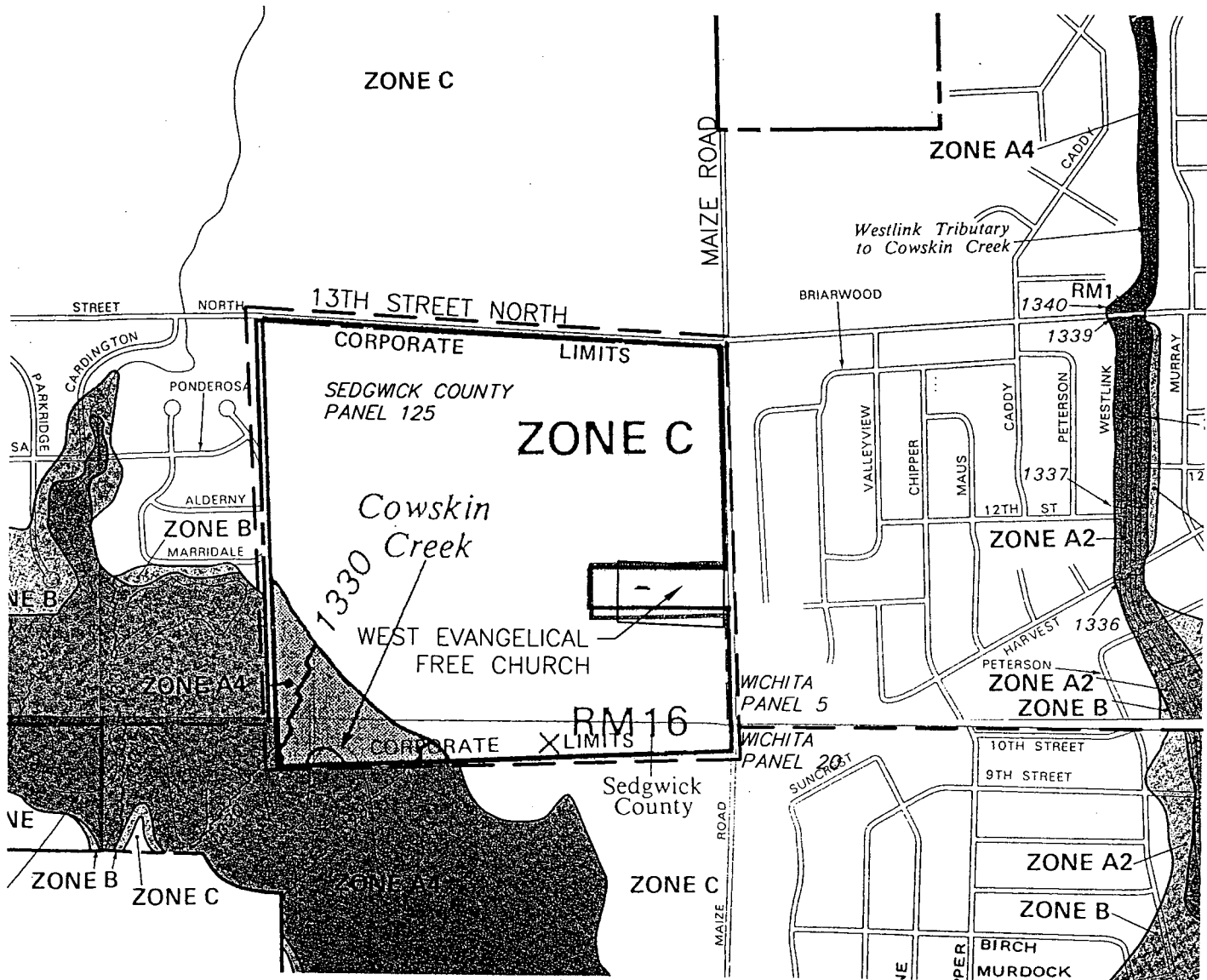
**DRK**  
CHECKED BY:

**APRIL 2003**  
DATE

**03053**  
JOB NO.

**1 / 1**  
SHEET/OF

**APPENDIX B**  
**FEMA FIRM MAP - PANEL 125 SEDGWICK COUNTY**



NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP

SEDGWICK, COUNTY, KANSAS (UNINCORPORATED AREAS)

PANEL 125 OF 308

COMMUNITY-PANEL NUMBER: 200321 0125 A  
EFFECTIVE DATE: JUNE 3, 1986

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP

CITY OF WICHITA, KANSAS SEDGWICK COUNTY

PANEL 5 OF 40  
SEE MAP INDEX FOR PANELS NOT PRINTED

COMMUNITY-PANEL NUMBER: 200328 0005 B  
EFFECTIVE DATE: MAY 15, 1986

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP

CITY OF WICHITA, KANSAS SEDGWICK COUNTY

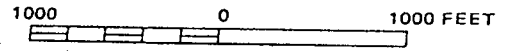
PANEL 20 OF 40  
SEE MAP INDEX FOR PANELS NOT PRINTED

COMMUNITY-PANEL NUMBER: 200328 0020 B  
EFFECTIVE DATE: MAY 15, 1986

Federal Emergency Management Agency



APPROXIMATE SCALE



**MKEC**  
ENGINEERING CONSULTANTS  
411 N. WEBB ROAD  
WICHITA, KS. 67206  
316 - 684 - 9600

**WEST EVANGELICAL FREE CHURCH**  
PROJECT NAME  
**SEDGWICK, COUNTY, KANSAS AND WICHITA, KANSAS FIRM PANELS**  
SHEET TITLE

<b>KLA</b> DESIGN BY.	<b>KLA</b> DRAWN BY.	<b>DRK</b> CHECKED BY.
<b>APRIL 2003</b> DATE	<b>03053</b> JOB NO.	<b>1 / 1</b> SHEET/OF

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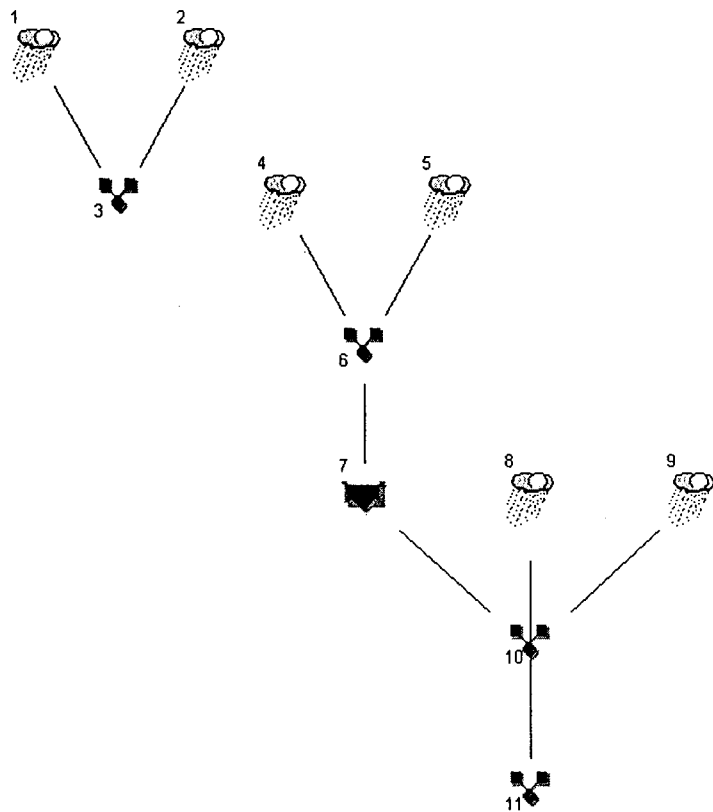
**APPENDIX C  
EXISTING CONDITIONS MAP**



**APPENDIX D**  
**PROPOSED CONDITIONS MAP/DETENTION PLAN**



**APPENDIX E**  
**HYDRAFLOW HYDROGRAPHS OUTPUT**  
**(EXISTING & PROPOSED)**



# Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (acft)	Hydrograph description
1	Rational	8.56	1	15	0.177	---	----	----	Area A - Existing
2	Rational	3.03	1	20	0.084	---	----	----	Area B - Existing
3	Combine	10.84	1	15	0.261	1, 2	----	----	Total Undeveloped
4	Rational	5.62	1	15	0.116	---	----	----	Area A Proposed
5	Rational	2.30	1	20	0.063	---	----	----	Area B proposed
6	Combine	7.35	1	15	0.180	4, 5	----	----	Total to Detention Pond
7	Reservoir	1.29	1	30	0.092	6	1339.06	0.150	Proposed Det. pond
8	Rational	92.84	1	30	3.836	---	----	----	Offsite Flow
9	Rational	7.00	1	15	0.145	---	----	----	Area C Proposed to Reserve
10	Combine	7.00	1	15	0.237	7, 9	----	----	Total from site
11	Combine	94.13	1	30	4.073	8, 10	----	----	Total Proposed Flow to Reserve

# Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (acft)	Hydrograph description
1	Rational	10.12	1	15	0.209	---	----	----	Area A - Existing
2	Rational	3.62	1	20	0.100	---	----	----	Area B - Existing
3	Combine	12.83	1	15	0.309	1, 2	----	----	Total Undeveloped
4	Rational	6.65	1	15	0.137	---	----	----	Area A Proposed
5	Rational	2.75	1	20	0.076	---	----	----	Area B proposed
6	Combine	8.71	1	15	0.213	4, 5	----	----	Total to Detention Pond
7	Reservoir	1.21	1	31	0.088	6	1339.15	0.189	Proposed Det. pond
8	Rational	112.65	1	30	4.655	---	----	----	Offsite Flow
9	Rational	8.27	1	15	0.171	---	----	----	Area C Proposed to Reserve
10	Combine	8.27	1	15	0.259	7, 9	----	----	Total from site
11	Combine	113.87	1	30	4.914	8, 10	----	----	Total Proposed Flow to Reserve

Proj. file: west e free detention-5yr.gpj Return Period: 5 yr

Run date: 04-09-2003

# Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (acft)	Hydrograph description
1	Rational	11.62	1	15	0.240	---	----	----	Area A - Existing
2	Rational	4.17	1	20	0.115	---	----	----	Area B - Existing
3	Combine	14.74	1	15	0.355	1, 2	----	----	Total Undeveloped
4	Rational	7.63	1	15	0.158	---	----	----	Area A Proposed
5	Rational	3.17	1	20	0.087	---	----	----	Area B proposed
6	Combine	10.00	1	15	0.245	4, 5	----	----	Total to Detention Pond
7	Reservoir	0.78	1	35	0.036	6	1339.26	0.234	Proposed Det. pond
8	Rational	130.74	1	30	5.402	---	----	----	Offsite Flow
9	Rational	9.49	1	15	0.196	---	----	----	Area C Proposed to Reserve
10	Combine	9.49	1	15	0.232	7, 9	----	----	Total from site
11	Combine	131.42	1	30	5.634	8, 10	----	----	Total Proposed Flow to Reserve

Proj. file: west e free detention-10yr 3yr return Period: 10 yr

Run date: 04-09-2003

# Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (acft)	Hydrograph description
1	Rational	16.39	1	15	0.339	---	----	----	Area A - Existing
2	Rational	5.92	1	20	0.163	---	----	----	Area B - Existing
3	Combine	20.83	1	15	0.502	1, 2	----	----	Total Undeveloped
4	Rational	10.76	1	15	0.222	---	----	----	Area A Proposed
5	Rational	4.49	1	20	0.124	---	----	----	Area B proposed
6	Combine	14.13	1	15	0.346	4, 5	----	----	Total to Detention Pond
7	Reservoir	0.00	1	0	0.000	6	1339.53	0.346	Proposed Det. pond
8	Rational	187.76	1	30	7.759	---	----	----	Offsite Flow
9	Rational	13.39	1	15	0.277	---	----	----	Area C Proposed to Reserve
10	Combine	13.39	1	15	0.277	7, 9	----	----	Total from site
11	Combine	187.76	1	30	8.035	8, 10	----	----	Total Proposed Flow to Reserve

Proj. file: west e free detention-100yr Run Period: 100 yr

Run date: 04-09-2003

# Hydrograph Report

## Hyd. No. 1

Area A - Existing

Hydrograph type = Rational  
Storm frequency = 100 yrs  
Drainage area = 3.1 ac  
Intensity = 7.365 in/hr  
IDF Curve = Sedgwick County.IDF

Peak discharge = 16.39 cfs  
Time interval = 1 min  
Runoff coeff. = 0.72  
Time of conc. (Tc) = 15 min  
Asc/Rec limb fact = 1/1

Hydrograph Volume = 0.339 acft

## Hydrograph Discharge Table

**Time -- Outflow**  
**(hrs      cfs)**

0.18	12.02
0.20	13.11
0.22	14.20
0.23	15.29
0.25	16.39 <<
0.27	15.29
0.28	14.20
0.30	13.11
0.32	12.02

...End

# Hydrograph Report

## Hyd. No. 2

Area B - Existing

Hydrograph type	= Rational	Peak discharge	= 5.92 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 2.5 ac	Runoff coeff.	= 0.37
Intensity	= 6.530 in/hr	Time of conc. (Tc)	= 20 min
IDF Curve	= Sedgwick County.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 0.163 acft

## Hydrograph Discharge Table

Time -- Outflow  
(hrs      cfs)

0.25	4.44
0.27	4.74
0.28	5.03
0.30	5.33
0.32	5.62
0.33	5.92 <<
0.35	5.62
0.37	5.33
0.38	5.03
0.40	4.74
0.42	4.44
0.43	4.14

...End

# Hydrograph Report

## Hyd. No. 3

Total Undeveloped

Hydrograph type = Combine  
Storm frequency = 100 yrs  
Inflow hyds. = 1, 2

Peak discharge = 20.83 cfs  
Time interval = 1 min

Hydrograph Volume = 0.502 acft

## Hydrograph Discharge Table

Time (hrs)	Hyd. 1 + (cfs)	Hyd. 2 = (cfs)	Outflow (cfs)
0.18	12.02	3.26	15.27
0.20	13.11	3.55	16.66
0.22	14.20	3.85	18.05
0.23	15.29	4.14	19.44
0.25	16.39 <<	4.44	20.83 <<
0.27	15.29	4.74	20.03
0.28	14.20	5.03	19.23
0.30	13.11	5.33	18.44
0.32	12.02	5.62	17.64
0.33	10.92	5.92 <<	16.84
0.35	9.83	5.62	15.45

...End

# Hydrograph Report

## Hyd. No. 4

Area A Proposed

Hydrograph type	= Rational	Peak discharge	= 10.76 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 1.7 ac	Runoff coeff.	= 0.88
Intensity	= 7.365 in/hr	Time of conc. (Tc)	= 15 min
IDF Curve	= Sedgwick County.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 0.222 acft

## Hydrograph Discharge Table

**Time -- Outflow**  
(hrs      cfs)

0.18	7.89
0.20	8.61
0.22	9.32
0.23	10.04
0.25	10.76 <<
0.27	10.04
0.28	9.32
0.30	8.61
0.32	7.89

...End

# Hydrograph Report

## Hyd. No. 5

Area B proposed

Hydrograph type	= Rational	Peak discharge	= 4.49 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 1.9 ac	Runoff coeff.	= 0.37
Intensity	= 6.530 in/hr	Time of conc. (Tc)	= 20 min
IDF Curve	= Sedgwick County.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 0.124 acft

## Hydrograph Discharge Table

**Time -- Outflow**  
**(hrs      cfs)**

0.23	3.15
0.25	3.37
0.27	3.60
0.28	3.82
0.30	4.04
0.32	4.27
0.33	4.49 <<
0.35	4.27
0.37	4.04
0.38	3.82
0.40	3.60
0.42	3.37
0.43	3.15

*...End*

# Hydrograph Report

## Hyd. No. 6

Total to Detention Pond

Hydrograph type = Combine  
Storm frequency = 100 yrs  
Inflow hyds. = 4, 5

Peak discharge = 14.13 cfs  
Time interval = 1 min

Hydrograph Volume = 0.346 acft

## Hydrograph Discharge Table

Time (hrs)	Hyd. 4 + (cfs)	Hyd. 5 = (cfs)	Outflow (cfs)
0.18	7.89	2.47	10.36
0.20	8.61	2.70	11.30
0.22	9.32	2.92	12.25
0.23	10.04	3.15	13.19
0.25	10.76 <<	3.37	14.13 <<
0.27	10.04	3.60	13.64
0.28	9.32	3.82	13.14
0.30	8.61	4.04	12.65
0.32	7.89	4.27	12.16
0.33	7.17	4.49 <<	11.67
0.35	6.46	4.27	10.72

...End

# Hydrograph Report

## Hyd. No. 7

Proposed Det. pond

Hydrograph type = Reservoir  
Storm frequency = 100 yrs  
Inflow hyd. No. = 6  
Max. Elevation = 1339.53 ft

Peak discharge = 0.00 cfs  
Time interval = 1 min  
Reservoir name = New Pond5  
Max. Storage = 0.346 acft

Storage Indication method used.

Outflow hydrograph volume = 0.000 acft

...End



# Hydrograph Report

## Hyd. No. 8

Offsite Flow

Hydrograph type	= Rational	Peak discharge	= 187.76 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 57.0 ac	Runoff coeff.	= 0.61
Intensity	= 5.400 in/hr	Time of conc. (Tc)	= 30 min
IDF Curve	= Sedgwick County.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 7.759 acft

## Hydrograph Discharge Table

Time -- Outflow  
(hrs      cfs)

0.35	131.43
0.37	137.69
0.38	143.95
0.40	150.21
0.42	156.47
0.43	162.72
0.45	168.98
0.47	175.24
0.48	181.50
0.50	187.76 <<
0.52	181.50
0.53	175.24
0.55	168.98
0.57	162.72
0.58	156.47
0.60	150.21
0.62	143.95
0.63	137.69

...End

# Hydrograph Report

## Hyd. No. 9

Area C Proposed to Reserve

Hydrograph type	= Rational	Peak discharge	= 13.39 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 2.0 ac	Runoff coeff.	= 0.9
Intensity	= 7.365 in/hr	Time of conc. (Tc)	= 15 min
IDF Curve	= Sedgwick County.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Volume = 0.277 acft

## Hydrograph Discharge Table

Time -- Outflow  
(hrs      cfs)

0.18	9.82
0.20	10.71
0.22	11.60
0.23	12.50
0.25	13.39 <<
0.27	12.50
0.28	11.60
0.30	10.71
0.32	9.82

...End

# Hydrograph Report

## Hyd. No. 10

Total from site

Hydrograph type = Combine  
Storm frequency = 100 yrs  
Inflow hyds. = 7, 9

Peak discharge = 13.39 cfs  
Time interval = 1 min

Hydrograph Volume = 0.277 acft

### Hydrograph Discharge Table

Time (hrs)	Hyd. 7 + (cfs)	Hyd. 9 = (cfs)	Outflow (cfs)
0.18	0.00 <<	9.82	9.82
0.20	0.00 <<	10.71	10.71
0.22	0.00 <<	11.60	11.60
0.23	0.00 <<	12.50	12.50
0.25	0.00 <<	13.39 <<	13.39 <<
0.27	0.00 <<	12.50	12.50
0.28	0.00 <<	11.60	11.60
0.30	0.00 <<	10.71	10.71
0.32	0.00 <<	9.82	9.82

...End

# Hydrograph Report

## Hyd. No. 11

Total Proposed Flow to Reserve

Hydrograph type = Combine  
Storm frequency = 100 yrs  
Inflow hyds. = 8, 10

Peak discharge = 187.76 cfs  
Time interval = 1 min

Hydrograph Volume = 8.035 acft

## Hydrograph Discharge Table

Time (hrs)	Hyd. 8 + (cfs)	Hyd. 10 = (cfs)	Outflow (cfs)
0.33	125.17	8.93	134.10
0.35	131.43	8.03	139.46
0.37	137.69	7.14	144.83
0.38	143.95	6.25	150.20
0.40	150.21	5.36	155.56
0.42	156.47	4.46	160.93
0.43	162.72	3.57	166.29
0.45	168.98	2.68	171.66
0.47	175.24	1.79	177.03
0.48	181.50	0.89	182.39
0.50	187.76 <<	0.00	187.76 <<
0.52	181.50	0.00	181.50
0.53	175.24	0.00	175.24
0.55	168.98	0.00	168.98
0.57	162.72	0.00	162.72
0.58	156.47	0.00	156.47
0.60	150.21	0.00	150.21
0.62	143.95	0.00	143.95
0.63	137.69	0.00	137.69

...End