

**DRAINAGE REPORT
FOR
CENTRAL DEVELOPMENT ADDITION
WICHITA, SEDGWICK COUNTY,
KANSAS**

January 5, 2006

**CENTRAL DEVELOPMENT ADDITION
DRAINAGE ANALYSIS
January 5, 2006**

INTRODUCTION

This report contains supporting documentation and calculations for the proposed Central Development Addition. The existing site is an undeveloped 36 acre tract of land located west of the northwest corner of Central Ave. and K-96 highway. The area is currently pasture land with two major drainage ways through the site. The first drainage way crosses the southwest corner of the property and the other is near the easterly side of the property flowing from north to south. Existing off-site drainage enters the site from one location on the west and two locations on the north lines of this property.

The drainage from the north comes from three (3) 8.5 sq. ft. RCPH pipes under K-96 that drain the K-96 right-of-way on the east and a 7' x 4' RCB from Balthrop 4th Addition on the west. The drainage crossing the southwest corner of the property discharges from a pond just west of the subject property and drains approximately 424 acres to the west and north. Both drainage ways are controlled by existing reinforced concrete box culverts (RCB's) under Central Avenue.

The site will be developed into residential lots with on-site detention to be accomplished using the two (2) existing ponds in the center of the property, which will be combined into a single common pond. Detention for this site will also include the required detention for the Balthrop 4th Addition. The pond will also provide detention storage for approximately 7 acres of ground adjacent to and east of the east line of the addition in its fully developed condition as commercial property.

HYDROLOGY

Peak flow rates for the offsite flows were determined from a combination of drainage data from Professional Engineering Consultants, P.A. for the Balthrop 4th Addition and the U.S. Army Corps of Engineers HEC-HMS model. The HY-8 data from the box culverts under Central Ave. was used in the model as downstream controls for this site. Additional information was obtained from the drainage map and plan and profile sheets of the construction plans for Central Avenue, County Project No. 618-34 dated July 1997.

The rational method was used to determine peak flow rates for the basins located within the plat. See the "Hydrology Data" section of this report for calculations and results for this project.

HYDRAULICS

Hydraulic characteristics and design for the channels and outfall structures for the ponds were determined using the Haestad Methods Open Channel Flow Module.

CONCLUSION

The single detention pond will provide sufficient storage to detain the necessary flow from both this site, Balthrop 4th Addition, and the adjacent 7 acres to the east. A Weir structure must be constructed on the existing pond to provide detention storage. The discharge point from the pond to Central Avenue shall have a thirty foot (30') broad-crested weir.

Pond Summary

(2-yr and 5-yr design storm included for information only)

2-year Design Storm

Q_2 Undeveloped = 71 cfs

24-hr Cum. Rainfall = 3.5 in.

Q_2 In = 201 cfs

Q_2 Out = 70.7 cfs

Peak Storage = 11.07 ac-ft.

Peak El. = 1352.1

5-year Design Storm

Q_5 Undeveloped = 155 cfs

24-hr Cum. Rainfall = 4.5 in.

Q_5 In = 283.5 cfs

Q_5 Out = 133.1 cfs

Peak Storage = 14.4 ac-ft.

Peak El. = 1352.7

100-year Design Storm

Q_{100} Undeveloped = 419 cfs

24-hr Cum. Rainfall = 7.8 in.

Q_{100} In = 567 cfs

Q_{100} Out = 389 cfs

Peak Storage = 22.4 ac-ft.

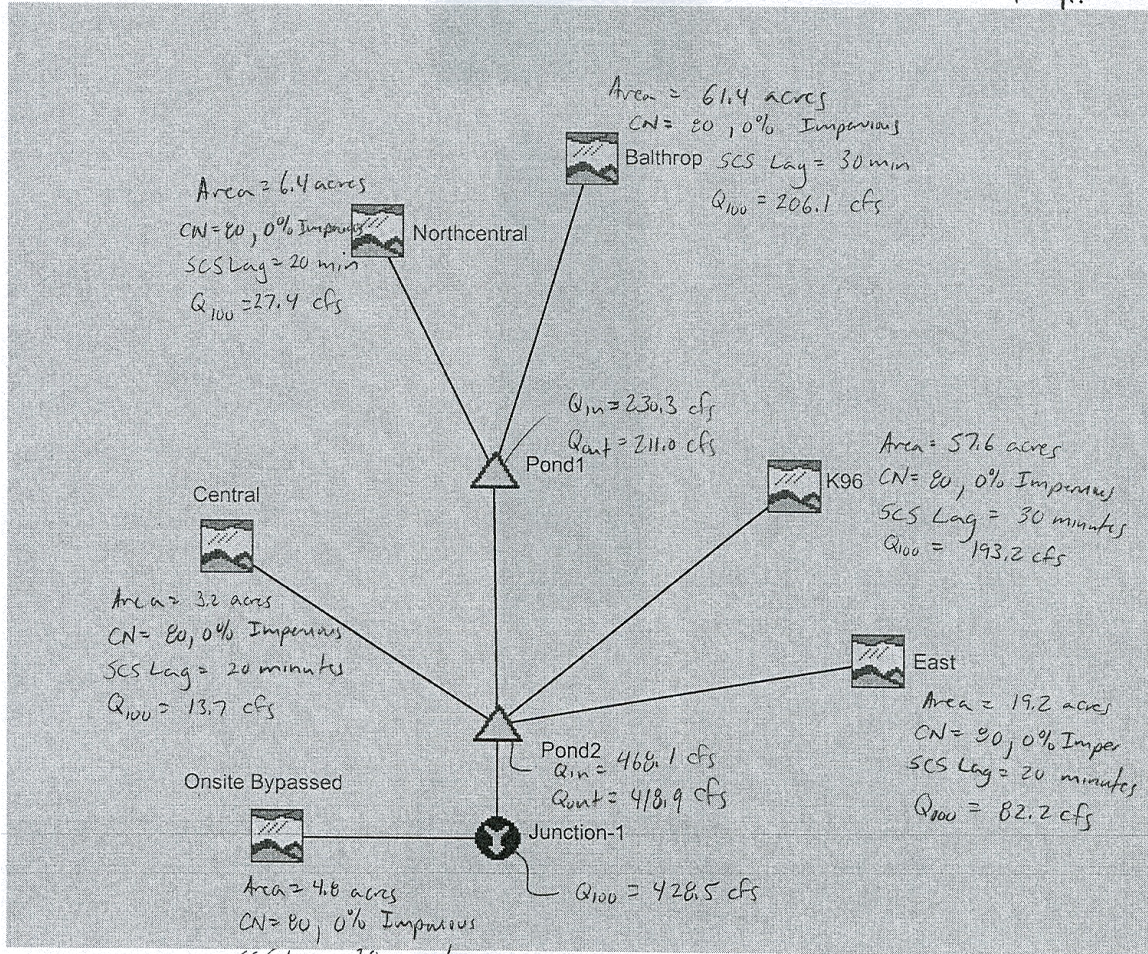
Peak El. = 1354.1

Weir Discharge
 Calculations
 Central Development Addition

30 foot Wide 2-stage Broad Crested Weir
 Use C from Handbook of Hydraulics, King and Brater

Elevation	H	C	L	Q						Q Total
1350	0	0	6.75	0						0
1350.5	0.5	2.9	6.75	6.9						6.9
1351	1	3.2	6.75	21.6						21.6
1351.5	1.5	3.31	6.75	41.0	Elevation	H	C	L	Q	41.0
1352.2	2.2	3.32	6.75	73.1	1352.2	0	0	23.25	0	73.1
1352.5	2.5	3.32	6.75	88.6	1352.5	0.3	2.9	23.25	11.079	99.7
1353	3	3.32	6.75	116.4	1353	0.8	3.2	23.25	53.236	169.7
1353.5	3.5	3.32	6.75	146.7	1353.5	1.3	3.31	23.25	114.07	260.8
1354	4	3.32	6.75	179.3	1354	1.8	3.32	23.25	186.41	365.7
1354.5	4.5	3.32	6.75	213.9	1354.5	2.3	3.32	23.25	269.25	483.2
1355	5	3.32	6.75	250.6	1355	2.8	3.32	23.25	361.66	612.2
1355.5	5.5	3.32	6.75	289.1	1355.5	3.3	3.32	23.25	462.73	751.8
1356	6	3.32	6.75	329.4	1356	3.8	3.32	23.25	571.79	901.1
1357	7	3.32	6.75	415.0	1357	4.8	3.32	23.25	811.75	1226.8
1358	8	3.32	6.75	507.1	1358	5.8	3.32	23.25	1078.2	1585.3
1359	9	3.32	6.75	605.1	1359	6.8	3.32	23.25	1368.8	1973.8
1360	10	3.32	6.75	708.7	1360	7.8	3.32	23.25	1681.5	2390.2

Pre-Development Condition
w/ As-Surveyed Conditions
Including Unimproved Balthrop 4th Addn.
100-yr.



HMS * Summary of Results

Project : ktp Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL
 End of Run : 29Aug01 1200 Met. Model : 100
 Execution Time : 30Nov05 1722 Control Specs : 100

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
Northcentral	27.413	29 Aug 01 0010	2.8809	0.010
Balthrop	206.11	29 Aug 01 0020	27.566	0.096
Pond1	210.97	29 Aug 01 0030	27.150	0.106
Central	13.706	29 Aug 01 0010	1.4405	0.005
K96	193.22	29 Aug 01 0020	25.843	0.090
East	82.238	29 Aug 01 0010	8.6428	0.030
Pond2	418.92	29 Aug 01 0035	62.570	0.231
Onsite Bypassed	20.834	29 Aug 01 0010	2.1895	0.008
Junction-1	428.51	29 Aug 01 0035	64.759	0.239

HMS * Summary of Results for Junction-1

Project : ktp

Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL

End of Run : 29Aug01 1200 Met. Model : 100

Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Outflow : 428.51 (cfs) Date/Time of Peak Outflow : 29 Aug 01 0035

Total Outflow : 5.09 (in)

HMS * Summary of Results for Pond1

Project : ktp Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL

End of Run : 29Aug01 1200 Met. Model : 100

Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Inflow : 230.27 (cfs) Date/Time of Peak Inflow : 29 Aug 01 0020

Peak Outflow : 210.97 (cfs) Date/Time of Peak Outflow : 29 Aug 01 0030

Total Inflow : 5.39 (in) Peak Storage : 5.7237(ac-ft)

Total Outflow : 4.80 (in) Peak Elevation : 1357.0(ft)

HMS * Summary of Results for Pond2

Project : ktp Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL

End of Run : 29Aug01 1200 Met. Model : 100

Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Inflow : 468.05 (cfs) Date/Time of Peak Inflow : 29 Aug 01 0025

Peak Outflow : 418.92 (cfs) Date/Time of Peak Outflow : 29 Aug 01 0035

Total Inflow : 5.12 (in) Peak Storage : 7.7864(ac-ft)

Total Outflow : 5.08 (in) Peak Elevation : 1354.0(ft)

HMS * Summary of Results for Onsite
Bypassed

Project : ktp Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Discharge	: 20.834 (cfs)	Date/Time of Peak Discharge	: 29 Aug 01 0010
Total Precipitation	: 7.80 (in)	Total Direct Runoff	: 5.40 (in)
Total Loss	: 2.36 (in)	Total Baseflow	: 0.00 (in)
Total Excess	: 5.44 (in)	Total Discharge	: 5.40 (in)

HMS * Summary of Results for Central

Project : ktp Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Discharge : 13.706 (cfs) Date/Time of Peak Discharge : 29 Aug 01 0010
Total Precipitation : 7.80 (in) Total Direct Runoff : 5.40 (in)
Total Loss : 2.36 (in) Total Baseflow : 0.00 (in)
Total Excess : 5.44 (in) Total Discharge : 5.40 (in)

HMS * Summary of Results for Northcentral

Project : ktp Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Discharge : 27.413 (cfs) Date/Time of Peak Discharge : 29 Aug 01 0010
Total Precipitation : 7.80 (in) Total Direct Runoff : 5.40 (in)
Total Loss : 2.36 (in) Total Baseflow : 0.00 (in)
Total Excess : 5.44 (in) Total Discharge : 5.40 (in)

HMS * Summary of Results for Balthrop

Project : ktp Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Discharge : 206.11 (cfs) Date/Time of Peak Discharge : 29 Aug 01 0020
Total Precipitation : 7.80 (in) Total Direct Runoff : 5.38 (in)
Total Loss : 2.36 (in) Total Baseflow : 0.00 (in)
Total Excess : 5.44 (in) Total Discharge : 5.38 (in)

HMS * Summary of Results for K96

Project : ktp Run Name : KTP-UND-New

Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Discharge : 193.22 (cfs) Date/Time of Peak Discharge : 29 Aug 01 0020
Total Precipitation : 7.80 (in) Total Direct Runoff : 5.38 (in)
Total Loss : 2.36 (in) Total Baseflow : 0.00 (in)
Total Excess : 5.44 (in) Total Discharge : 5.38 (in)

HMS * Summary of Results for East

Project : ktp Run Name : KTP-UND-New

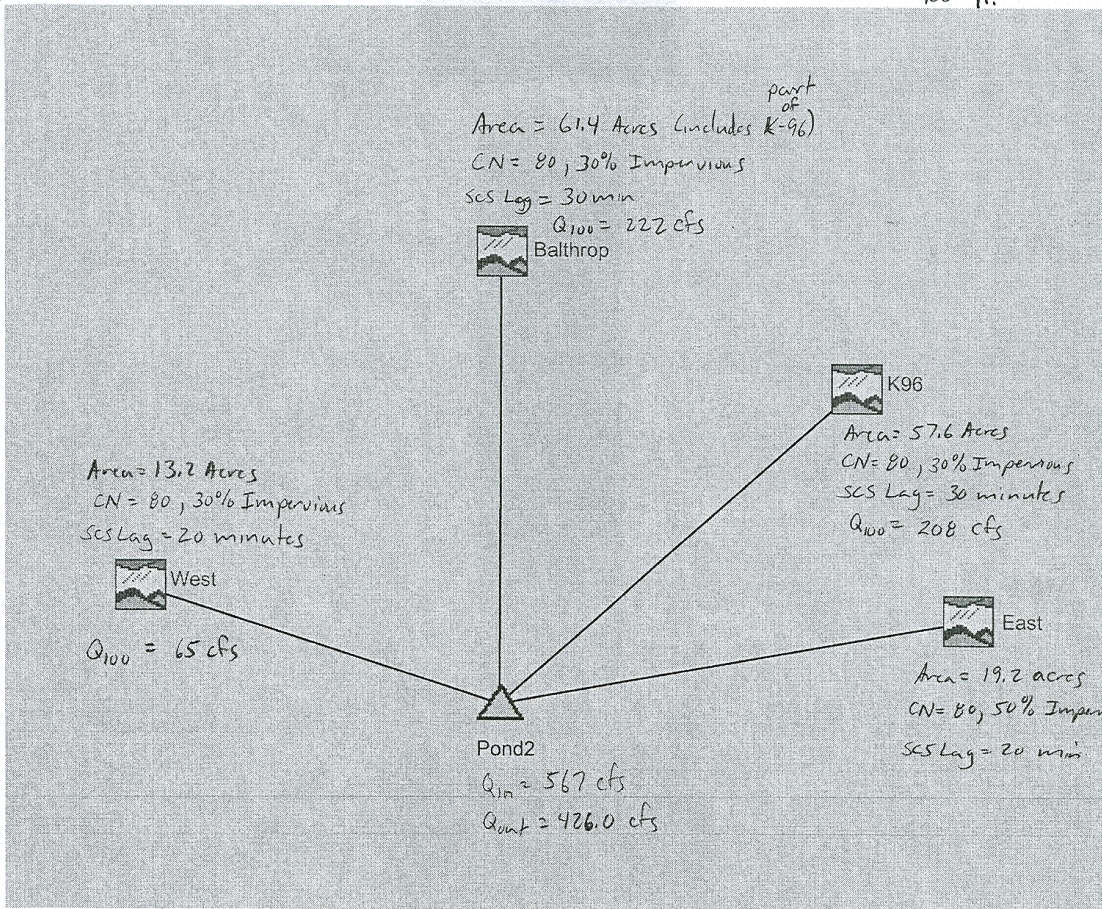
Start of Run : 28Aug01 1200 Basin Model : KTP-UND-KWL
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1722 Control Specs : 100

Computed Results

Peak Discharge : 82.238 (cfs) Date/Time of Peak Discharge : 29 Aug 01 0010
Total Precipitation : 7.80 (in) Total Direct Runoff : 5.40 (in)
Total Loss : 2.36 (in) Total Baseflow : 0.00 (in)
Total Excess : 5.44 (in) Total Discharge : 5.40 (in)

Developed Model (Balthrop 4th and Central Development) - Check Run.

100-46



HMS * Summary of Results

Project : ktp Run Name : KTP East

Start of Run : 28Aug01 1200 Basin Model : KTP-East
 End of Run : 29Aug01 1200 Met. Model : 100
 Execution Time : 30Nov05 1707 Control Specs : 100

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
West	64.622	29 Aug 01 0010	7.1361	0.022
Balthrop	222.21	29 Aug 01 0020	31.188	0.096
K96	208.32	29 Aug 01 0020	29.239	0.090
East	92.715	29 Aug 01 0010	10.531	0.030
Pond2	425.99	29 Aug 01 0035	76.641	0.238

2-year Design Storm

HMS * Summary of Results for Pond2

Project : ktp2 Run Name : Run 5

Start of Run : 28Aug01 1200 Basin Model : KTP-East

End of Run : 29Aug01 1200 Met. Model : 2

Execution Time : 05Jan06 1607 Control Specs : 100

Computed Results

Peak Inflow : 200.83 (cfs) Date/Time of Peak Inflow : 29 Aug 01 0020

Peak Outflow : 70.712 (cfs) Date/Time of Peak Outflow : 29 Aug 01 0100

Total Inflow : 2.22 (in) Peak Storage : 11.073(ac-ft)

Total Outflow : 2.48 (in) Peak Elevation : 1352.1(ft)

5-year Design Storm

HMS * Summary of Results for Pond2

Project : ktp2 Run Name : Run 6

Start of Run : 28Aug01 1200 Basin Model : KTP-East
End of Run : 29Aug01 1200 Met. Model : 5
Execution Time : 05Jan06 1604 Control Specs : 100

Computed Results

Peak Inflow : 283.45 (cfs) Date/Time of Peak Inflow : 29 Aug 01 0020
Peak Outflow : 133.09 (cfs) Date/Time of Peak Outflow : 29 Aug 01 0050
Total Inflow : 3.10 (in) Peak Storage : 14.387(ac-ft)
Total Outflow : 3.32 (in) Peak Elevation : 1352.7(ft)

100-year Design Storm

HMS * Summary of Results for Pond2

Project : ktp2 Run Name : Run 1

Start of Run : 28Aug01 1200 Basin Model : KTP-East
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 05Jan06 1608 Control Specs : 100

Computed Results

Peak Inflow : 567.33 (cfs) Date/Time of Peak Inflow : 29 Aug 01 0020
Peak Outflow : 389.19 (cfs) Date/Time of Peak Outflow : 29 Aug 01 0040
Total Inflow : 6.15 (in) Peak Storage : 22.350 (ac-ft)
Total Outflow : 6.26 (in) Peak Elevation : 1354.1 (ft)

HMS * Summary of Results for West

Project : ktp Run Name : KTP East

Start of Run : 28Aug01 1200 Basin Model : KTP-East
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1707 Control Specs : 100

Computed Results

Peak Discharge : 64.622 (cfs) Date/Time of Peak Discharge : 29 Aug 01 0010
Total Precipitation : 7.80 (in) Total Direct Runoff : 6.11 (in)
Total Loss : 1.65 (in) Total Baseflow : 0.00 (in)
Total Excess : 6.15 (in) Total Discharge : 6.11 (in)

HMS * Summary of Results for Balthrop

Project : ktp Run Name : KTP East

Start of Run : 28Aug01 1200 Basin Model : KTP-East
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1707 Control Specs : 100

Computed Results

Peak Discharge : 222.21 (cfs) Date/Time of Peak Discharge : 29 Aug 01 0020
Total Precipitation : 7.80 (in) Total Direct Runoff : 6.09 (in)
Total Loss : 1.65 (in) Total Baseflow : 0.00 (in)
Total Excess : 6.15 (in) Total Discharge : 6.09 (in)

HMS * Summary of Results for K96

Project : ktp Run Name : KTP East

Start of Run : 28Aug01 1200 Basin Model : KTP-East
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1707 Control Specs : 100

Computed Results

Peak Discharge	: 208.32 (cfs)	Date/Time of Peak Discharge	: 29 Aug 01 0020
Total Precipitation	: 7.80 (in)	Total Direct Runoff	: 6.09 (in)
Total Loss	: 1.65 (in)	Total Baseflow	: 0.00 (in)
Total Excess	: 6.15 (in)	Total Discharge	: 6.09 (in)

HMS * Summary of Results for East

Project : ktp Run Name : KTP East

Start of Run : 28Aug01 1200 Basin Model : KTP-East
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 30Nov05 1707 Control Specs : 100

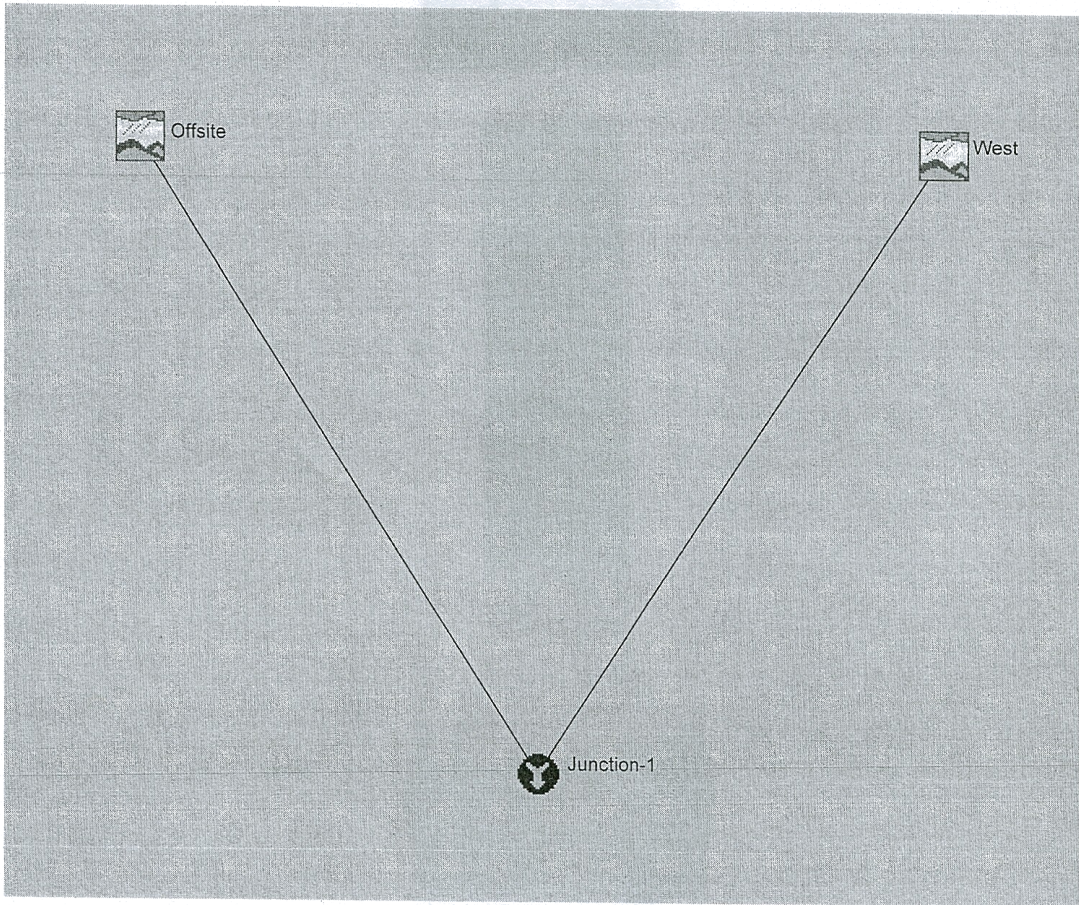
Computed Results

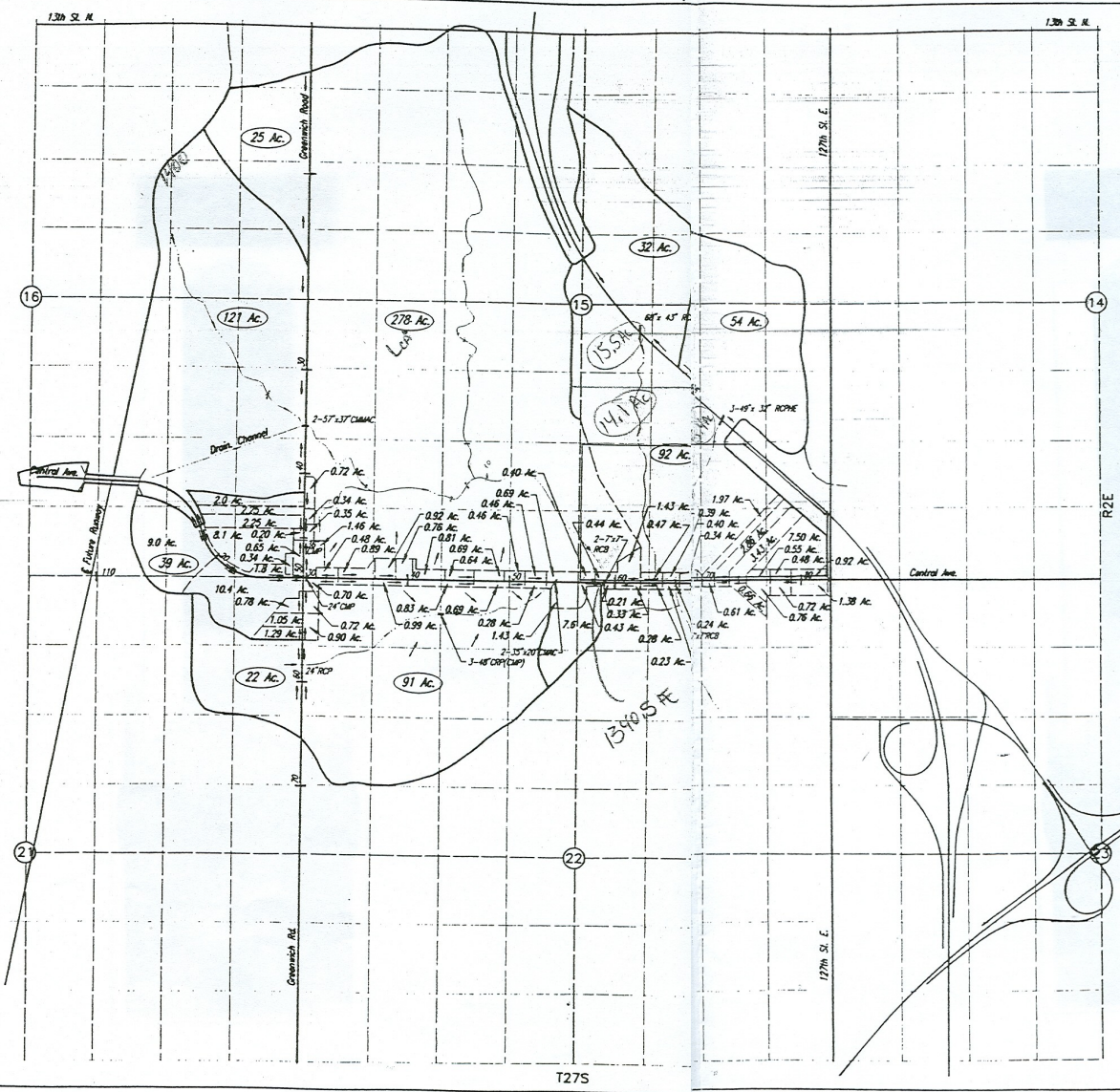
Peak Discharge	: 92.715 (cfs)	Date/Time of Peak Discharge	: 29 Aug 01 0010
Total Precipitation	: 7.80 (in)	Total Direct Runoff	: 6.58 (in)
Total Loss	: 1.18 (in)	Total Baseflow	: 0.00 (in)
Total Excess	: 6.62 (in)	Total Discharge	: 6.58 (in)

HEC-HMS

Project: KTP

Basin Model: KTP-UndW





PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
618-34	1998	ACD	450



- LEGEND**
- 22 Ac Total Basin Area to Cross Road Structure
 - 1.00 Ac Sub-basin Area to Storm Sewer Inlet
 - Major Basin Crest
 - - - Minor Basin

Note: Cross-road drainage structures shown are those existing prior to project improvements.

$$L = \frac{5280}{2450} \times \frac{3000}{6519} = 6,519 \text{ ft}$$

$$L_{cp} = \frac{5280}{2450} \times \frac{1800}{1370.5} = 3,911 \text{ ft}$$

$$S = \frac{1400 - 1370.5}{6519} \times 2800 = 48.2 \%$$

No.	Revision	By	Date
SEDCWICK COUNTY BUREAU OF PUBLIC SERVICES			
DRAINAGE MAP			
PROJECT NO. 618-34		SEDCWICK COUNTY	
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.			
MONTA, KANSAS			
Designed by:	JPS	Checked by:	WCH
Drawn by:	BA/AV	Date: Mar. 1997	Job No. 15797-2

T27S

120

Offsite Hydrology

West Offsite Drainage

Area = 424 acres +/- = 0.66 sq. mi

L = 6,519 ft = 1.23 mi

L_{CA} = 3,911 ft = 0.74 mi

Slope = 59.5 ft/ 6519 ft = 0.00913 ft/ft = 48.2 ft/mi

2 of the 4 parameters fit the requirement of the Snyder Unit Hydrograph Equation and the other 2 are close, so the Snyder parameters will be used for the west offsite basin.

See following page for data.

North Offsite Drainage Basins

Balthrop 4th Addition

All proposed flow rates taken from the Professional Engineering Consultants, P.A. Drainage Plan for Balthrop 4th Addition.

K-96 Right-of-Way

Area = 57.4 acres

T_C = 23 min.

I₁₀₀ = 6.13 in/hr

C = 0.69

Q₁₀₀ = 0.69(6.13)(57.4) = 242.8 cfs

Tulsa District Method for Estimating Snyder Parameters

The Tulsa District of the U. S. Army Corps of Engineers has developed the following equation for Snyder's watershed lag for natural watersheds in rural areas of central and northeastern Oklahoma.

$$T = 1.42 \times [(L \times Lca) / \text{sq. rt. } S]^{0.39}$$

in which:

- T = watershed lag in hours
- L = watershed length in miles
- Lca = length to centroid in miles
- S = watershed slope in feet per mile.

The range of hydrologic characteristics of the watersheds studied in developing this equation are as follows:

- Watershed Area: From 0.88 sq. mi. to 502 sq. mi.
- Watershed Slope: From 4.1 feet per mile to 82.1 feet per mile
- Watershed Length: From 1.4 miles to 60.5 miles
- Length to Centroid: From 0.6 miles to 33.0 miles

Basin Name	Area (acres)	Area (sq. mi.)	L (mi)	Lca (mi)	S (ft/mi)	T (hr)	qp (cfs/sq.mi.)	Cp (cf/sq.mi.)
KTP Offsite West	424.00	0.6625	1.23	0.74	48	0.64	570.53	0.573

HMS * Summary of Results

Project : KTP Run Name : Run 4

Start of Run : 28Aug01 1200 Basin Model : KTP-UndW
End of Run : 29Aug01 1200 Met. Model : 100
Execution Time : 04Sep01 1432 Control Specs : 100_West

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
Offsite	1136.5	29 Aug 01 0040	221.99	0.663
West	54.528	29 Aug 01 0015	4.9136	0.016
Junction-1	1153.7	29 Aug 01 0040	226.90	0.679

ANALYSIS OF EXISTING
CENTRAL AVENUE RCBCs

2 - 7'x7' RCB

CURRENT DATE: 08-30-2001
CURRENT TIME: 08:24:46

FILE DATE: 08-30-2001
FILE NAME: ktp_3

```

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0
C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 1340.80 1340.50 94.00 2 RCB 7.00 7.00 .012 CONVENTIONAL
2
3
4
5
6

```

SUMMARY OF CULVERT FLOWS (cfs) FILE: ktp_3 DATE: 08-30-2001

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1340.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1344.69	120.0	120.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1345.18	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1345.17	360.0	360.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1346.09	480.0	480.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1346.94	600.0	600.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1347.73	720.0	720.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1348.48	840.0	840.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1349.33	960.0	960.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1350.07	1080.0	1056.3	0.0	0.0	0.0	0.0	0.0	21.48	6
1350.22	1155.0	1075.8	0.0	0.0	0.0	0.0	0.0	71.26	5
1349.86	1029.3	1029.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: ktp_3 DATE: 08-30-2001

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1340.80	0.000	0.00	0.00	0.00
1344.69	0.000	120.00	0.00	0.00
1345.18	0.000	240.00	0.00	0.00
1345.17	0.000	360.00	0.00	0.00
1346.09	0.000	480.00	0.00	0.00
1346.94	0.000	600.00	0.00	0.00
1347.73	0.000	720.00	0.00	0.00
1348.48	0.000	840.00	0.00	0.00
1349.33	0.000	960.00	0.00	0.00
1350.07	-0.004	1080.00	2.22	0.21
1350.22	-0.007	1155.00	7.96	0.69

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

PERFORMANCE CURVE FOR CULVERT 1 - 2 (7.00 (ft) BY 7.00 (ft)) RCB

DIS- CHARGE FLOW (cfs)	HEAD- WATER ELEV. (ft)	INLET DEPTH (ft)	OUTLET DEPTH (ft)	CONTROL TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1340.80	0.00	-0.30	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
120.00	1344.69	1.96	3.89	1-S2n	1.26	1.32	1.26	1.61	6.79	4.52
240.00	1345.18	3.11	4.38	1-S2n	2.05	2.09	2.05	2.29	8.35	5.47
360.00	1345.17	4.12	4.37	3-M1t	2.75	2.74	2.79	2.79	9.22	6.10
480.00	1346.09	5.06	5.29	2-M2c	3.40	3.32	3.32	3.20	10.31	6.59
600.00	1346.94	5.94	6.14	2-M2c	4.02	3.86	3.86	3.55	11.11	6.98
720.00	1347.73	6.79	6.93	2-M2c	4.62	4.36	4.36	3.86	11.81	7.32
840.00	1348.48	7.65	7.68	2-M2c	5.22	4.83	4.83	4.15	12.43	7.62
960.00	1349.33	8.53	8.39	2-M2c	5.80	5.28	5.28	4.41	12.99	7.89
1056.30	1350.06	9.26	8.95	2-M2c	6.27	5.62	5.62	4.79	13.41	8.27
1075.78	1350.22	9.42	9.06	2-M2c	7.00	5.69	5.69	4.87	13.50	8.36

El. inlet face invert 1340.80 ft El. outlet invert 1340.50 ft
 El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT *****
 INLET STATION 0.00 ft
 INLET ELEVATION 1340.80 ft
 OUTLET STATION 94.00 ft
 OUTLET ELEVATION 1340.50 ft
 NUMBER OF BARRELS 2
 SLOPE (V/H) 0.0032
 CULVERT LENGTH ALONG SLOPE 94.00 ft

***** CULVERT DATA SUMMARY *****
 BARREL SHAPE BOX
 BARREL SPAN 7.00 ft
 BARREL RISE 7.00 ft
 BARREL MATERIAL CONCRETE
 BARREL MANNING'S n 0.012
 INLET TYPE CONVENTIONAL
 INLET EDGE AND WALL 1:1 BEVEL (45 DEG. FLARE)
 INLET DEPRESSION NONE

Onsite Hydrology

Proposed Runoff Data (All Basins)

Hydrologic Soil Group D

Assume single family residential development for all basins (1/4 Acre Lots).

$$C_2 = 0.50$$

$$C_{100} = 0.76$$

Assume all drainage areas have a T_C of 15 minutes, which is the minimum per the City of Wichita Design Criteria.

$$I_5 = 3.83 \text{ in/hr}$$

$$I_{100} = 7.37 \text{ in/hr}$$

Storm water sewer design and flow capacities are calculated with Haestad Methods STORM Cad program. Output from this program is included with this report. All starting hydraulic grade line elevations are calculated using the 100 year water surface of the detention pond = 1354.0 MSL (conservative).

Area A

Area = 3.8 acres

$$Q_2 = 0.50(3.83)(3.8) = 7.3 \text{ cfs}$$

$$Q_{100} = 0.76(7.37)(3.8) = 21.3 \text{ cfs}$$

Area A drains to a sump with two, 10' long type 1A Inlets, Inlet capacity at top of full curb for a 5' wide inlet = 7.0 cfs, for a 10' inlet = 14.0 cfs, therefore two 10' long inlet provide 28 cfs of capacity at top of curb elevation, which is greater than 21.3 cfs, OK.

Pipe system: Assume the west inlet will carry full inlet capacity (larger basin to this point), so $Q = 14$ cfs, cross street pipe should carry 14 cfs. See STORM Cad output for pipe sizes and HGL Information. STMC/Central Development/profileA.*

Area B

Area = 3.2 acres

$$Q_2 = 0.50(3.83)(3.2) = 6.1 \text{ cfs}$$

$$Q_{100} = 0.76(7.37)(3.2) = 17.9 \text{ cfs}$$

Area B will connect to the extension of the 4' x 7' RCBC from Balthrop North Addition. Proposed are three inlets, two of which will be 5' type 1A inlets, and the third, an inlet casting directly over the box. The combined inlet capacity at the sump will exceed 21.0 cfs, which is greater than the 17.9 cfs approach flow.

Upstream (match) flowline = 1351.52, length of extension to pond = 250 feet. Use a slope of 0.5% on the extension, resulting in a downstream flow line elevation of 1350.20.

From the PEC Drainage plan from Balthrop Addition, the flow in the 4' x 7' RCBC is 274 cfs. The HEC-RAS model included with this report indicates a flow of 226 cfs from the

same area. Check capacity of the 4' x 7' RCBC extension with STORM Cad with a total 100 year flow of 294 cfs. Result – HGL is < 1355.0 MSL, low sump = 1358.30, OK. Use connecting pipes of 18" RCP at 0.8%.

Area C

Area = 1.4 acres

$Q_2 = 0.50(3.83)(1.4) = 2.7 \text{ cfs}$

$Q_{100} = 0.76(7.37)(1.4) = 7.8 \text{ cfs}$

Assume no 100 year overflow available at this location. Inlet capacity, 10' inlet at sump at top of curb elevation will provide 14 cfs of capacity, OK.

From STORM-Cad, use 15" RCP to drain to pond.

Area D

Area = 3.9 acres

$Q_2 = 0.50(3.83)(3.9) = 7.5 \text{ cfs}$

$Q_{100} = 0.76(7.37)(3.9) = 21.8 \text{ cfs}$

This sump is served by two double Type 1A inlets over the top of a proposed 3'x10' RCBC under the roadway. As before, check capacity of a 3'x10' RCBC with the full 100 year flow. From the HEC-RAS model in this report, $Q_{100} = 212 \text{ cfs}$ from the K-96 area, combined with the local flow of 21.8 cfs, totaling 234 cfs. From the original KTP Drainage plan, the 100 year flow at this location is 240 cfs, therefore, use 240 cfs for analysis (conservative). Using the Land Development Desktop Culvert Calculator, the following input and output are calculated:

Culvert Calculator – East 10'x3' RCBC Under Plymouth

Entered Data:	
Shape	Rectangular
Number of Barrels	1
Solving for	Headwater
Chart Number	10
Scale Number	1
Chart Description	BOX CULVERT; 90-DEGREE HEADWALL; CHAMFERED
OR BEVELED INLET EDGES	
Scale Description	INLET EDGES CHAMFERED 3/4-INCH
Overtopping	Off
Flowrate	240.0000 cfs
Manning's n	0.0130
Roadway Elevation	1358.0000 ft
Inlet Elevation	1352.0000 ft
Outlet Elevation	1351.0000 ft
Height	36.0000 in
Width	120.0000 in
Length	60.0000 ft
Entrance Loss	0.5000
Tailwater	1354.0000 ft
Computed Results:	
Headwater	1355.5365 ft
Slope	0.0167 ft/ft
Velocity	8.8889 fps

This RCBC has an upstream tailwater elevation of 1355.6, which confines the flow within the drainage easement situated on the Balthrop North addition to the north. OK.

Inlet Grates: Neenah R-3077 Double Inlet Frame and Grate, at 0.6 feet of head, $Q = 11.2$ cfs per inlet, with two inlet, $Q = 22.4$ cfs in sump condition, without curb hood units. This exceeds the 100 year sump flow of 21.8 cfs without the companion curb opening hoods.

Inlet Hoods, R-3076-6B will add capacity, but not calculated given the grate capacity exceeds the inflow.

Area E

Area = 0.8 acres

$$Q_2 = 0.50(3.83)(0.8) = 1.5 \text{ cfs}$$

$$Q_{100} = 0.76(7.37)(0.8) = 4.5 \text{ cfs}$$

Use a 5' Type 1A inlet on each side of the street to intercept the flow.

Area F (Future Commercial Assumed)

Area = 6.1 acres

$$Q_5 = 0.69(4.56)(6.1) = 19.2 \text{ cfs}$$

$$Q_{100} = 0.80(7.37)(6.1) = 36.0 \text{ cfs}$$

For the undeveloped condition, the flow rate from Area F = 22.5 cfs (0.5 runoff coefficient). Need inlet and/or inlet/open pipe capacity to provide this flow. As the property develops, connections will be made to facilitate the site.

The Neenah R-2561 Beehive Frame and Gate in a sump condition can discharge 9.6 cfs, so for the undeveloped condition, use 3 Beehive Inlets, or a combination of Inlets and open pipe to collect the stormwater.

Area G

Area = 0.8 acres

$$Q_2 = 0.50(3.83)(0.8) = 1.5 \text{ cfs}$$

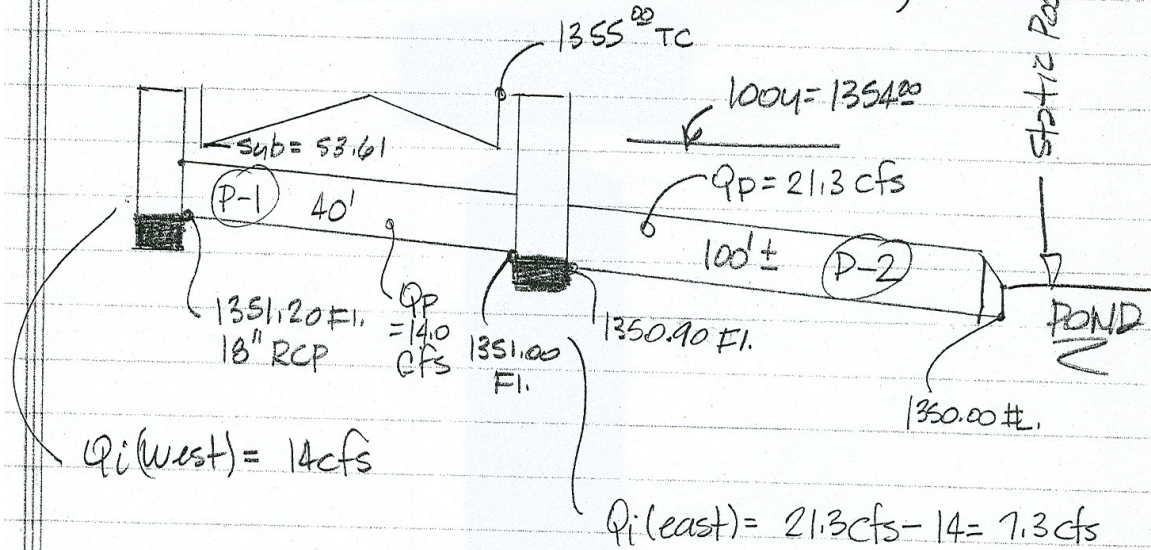
$$Q_{100} = 0.76(7.37)(0.8) = 4.5 \text{ cfs}$$

This area will drain into Central Avenue via the drive approach.

11-11-05
CMB

Central Development Addition:

Sump A (100 year overflow is Allowed.)



Stormcad Results (Profile A.dxf) } Central Development Folder

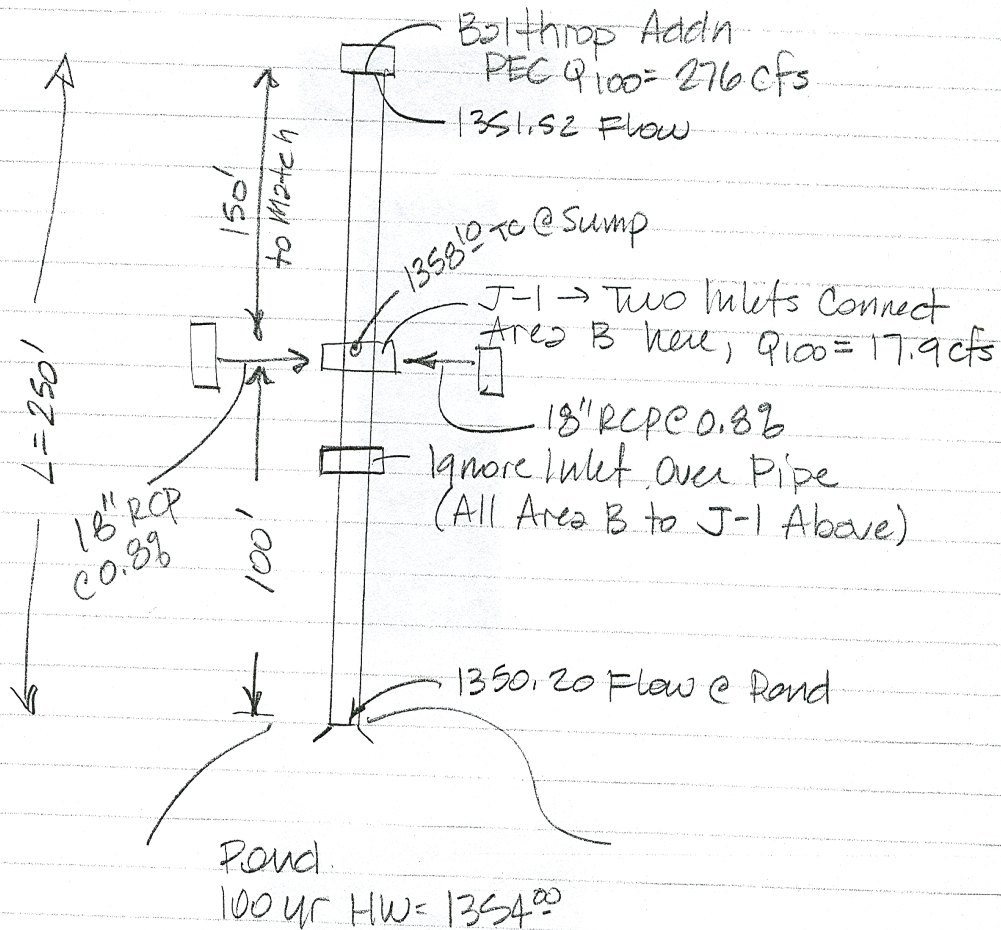
P-1 = 2-18" RCP's

P-2 = 1-36" RCP

HGL Under T.C. Elevation: OK

Central Development
Sump B (4' x 7' RCBC)

11/11/05
 CWB



With StormCAD; Q_{100} (entire length) = $276 + 17.9$
 = 294 cfs

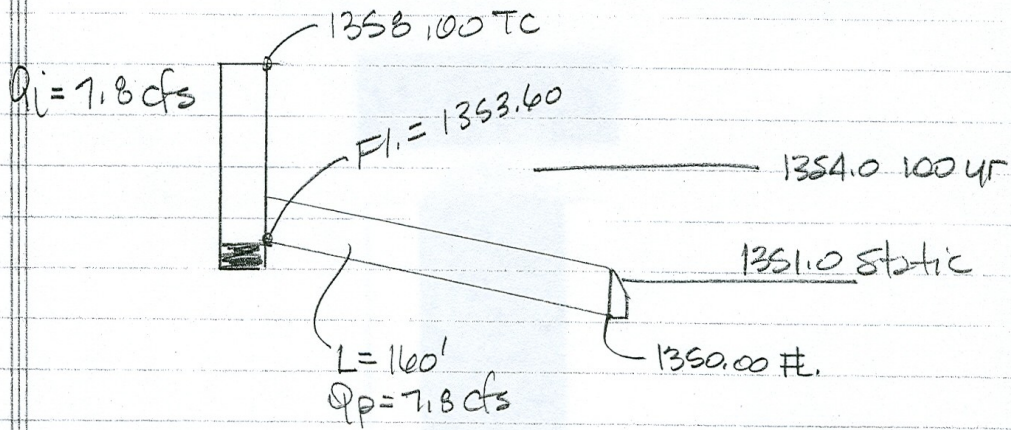
At full 100 yr Capacity, Max HGL < 1355 Elev;

lowest T.C = 1358.10 @ New Sump; O.K.

Connecting Pipes = 9 cfs each, Use 18" RCP C0.89; OK
 (Design Data 4- Mannings Gravity Flow)

Central Development Site
Sump C

11/11/05
CMZ



From Storm Cad - Use 15" RCP \rightarrow O.K.

Central Development

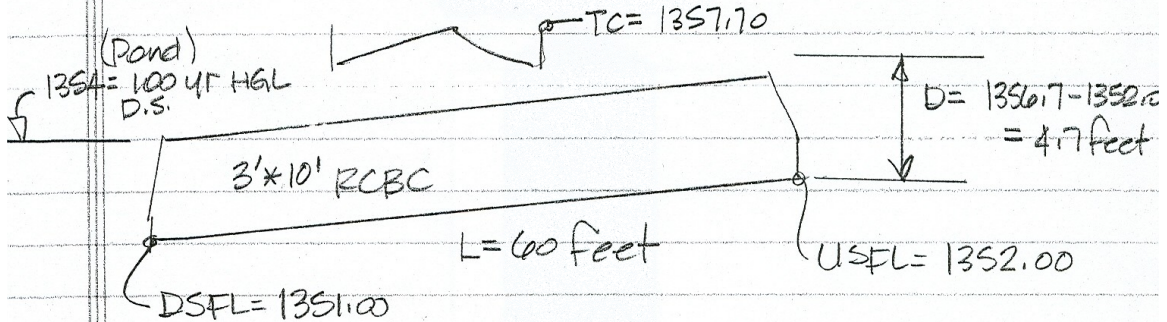
11/11/05
CWB

Swamp D, 3'x10' RCBC Under Roadway

Top of Curb Elevation @ Swamp = 1357.70

Max HGL = TC - 1.0 ft = 1356.70

100 yr. WS D.S. = 1354.00

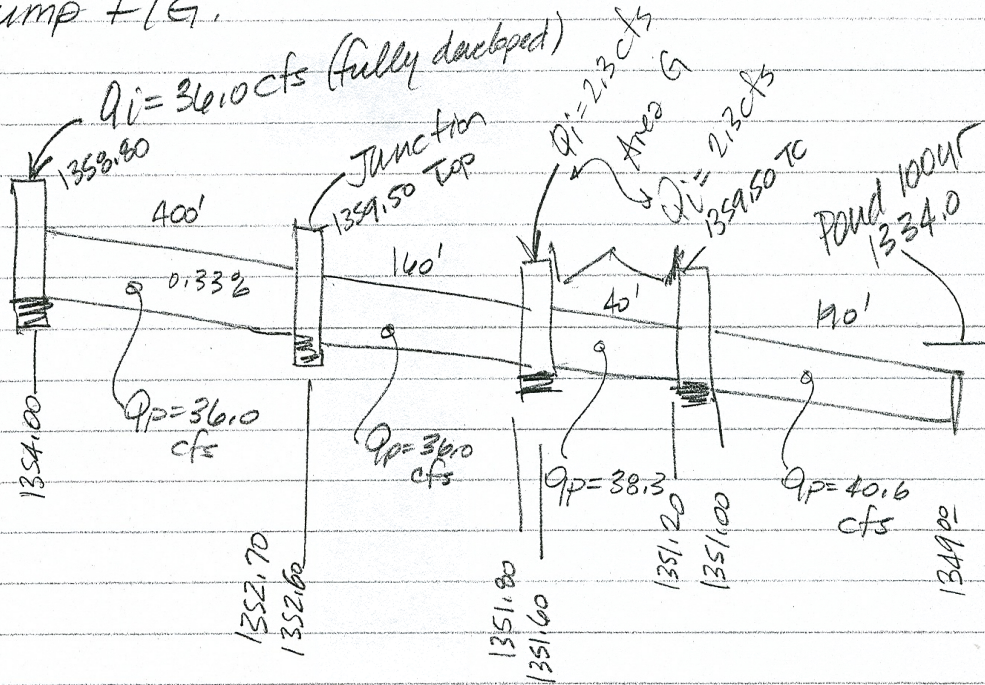


See output from LDD Culvert Calculator

Central Development

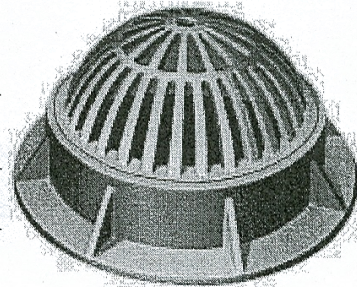
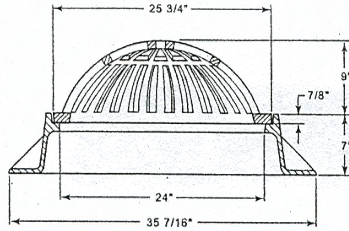
11/15/05
CUB

Sump #1/G.



NOTE: When specifying/ordering grates, refer to "CHOOSING THE PROPER INLET GRATE" on pages 108-109. For FREE OPEN AREAS of Neenah Grates, refer to pages 326-330.

**R-2561
High Beehive Grate and Frame**



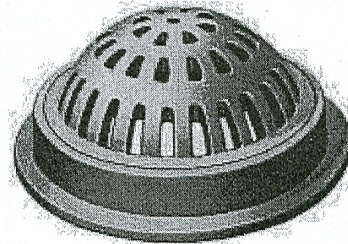
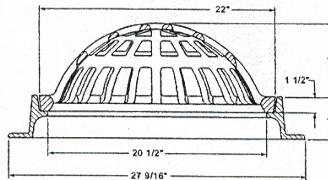
Uses R-1733 frame.

R-2561-A

Same as R-2561 except with 6" high beehive grate.
Furnished standard with as-cast bearing surfaces.

**R-2563
Beehive Grate and Frame**

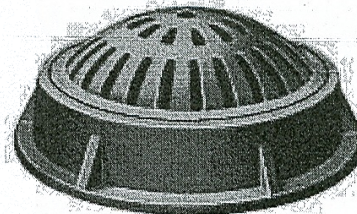
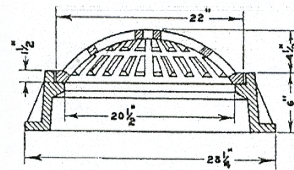
Designed to fit in bell of 24" sewer pipe.
Furnished standard with as-cast bearing surfaces.



Uses R-1690 frame.

**R-2564
Beehive Grate and Frame**

Designed to fit in bell of 24" sewer pipe.
Furnished standard with as-cast bearing surfaces.



Uses R-1761 frame.

Weir & Orifice Flow Comparison

$Q = 0.6A\sqrt{2gh}$
 (Orifice Flow Equation)

Q = Capacity in CFS
 A = Free open area of grate in sq. ft.
 g = 32.2 (feet per sec/sec)
 h = Head in feet

Orifice Information

- Instructions:*
- Either Select catalog number (will automatically fill in Open Area and Perimeter) or enter your own values
 - Enter head value
 - Press CALCULATE

The results will determine automatically if your situation falls into a Weir, Transitional or Orifice flow. Additionally, a pop-up window will offer Neenah grates which fall within the parameters chosen.

$Q = 3.3P(h)^{1.5}$
 (Weir Equation)

Q = Capacity in CFS
 P = Feet perimeter
 h = Head in feet

Weir Information

Catalog number and grate type:

Head in feet (h):

Feet perimeter (P):

Calculate

Free open area in sq. ft. (A):

Weir capacity in cfs:

Transitional flow in cfs:

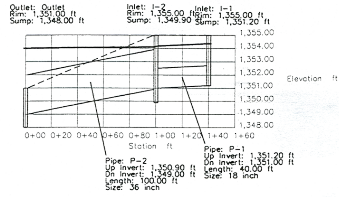
Orifice capacity in cfs:

(Results assume no debris restriction.)

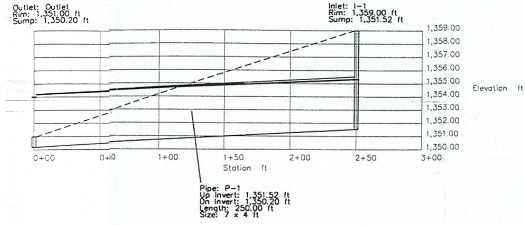
NOTE: The above results do not account for the dome height of Beehive-type grates. Please take note of this when determining the Head (h) value.

For additional information regarding Neenah Inlet Grate Capacities, please contact our Product Engineer, Steve Akkala, at 920-725-7000 or at sakkala@nfco.com.

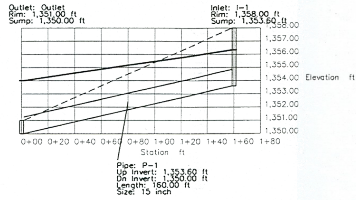
LINE A PROFILE



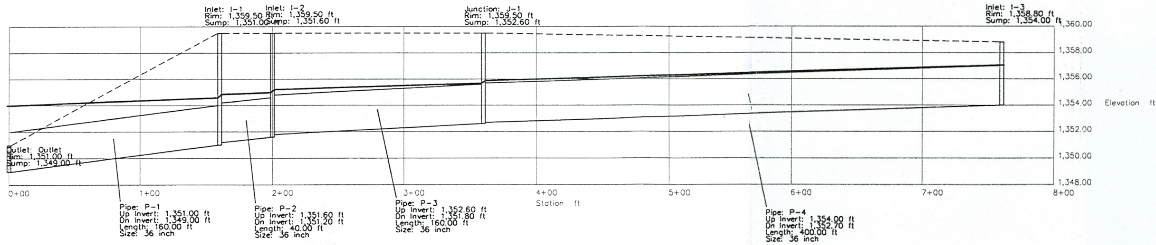
LINE B PROFILE



LINE C PROFILE



LINE F/G PROFILE



CENTRAL DEVELOPMENT
SERIES 1 SWS PROFILES



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DATE: 11-15-05
PROJECT NUMBER:

DESIGN	CMR	DATE	
DRAWN	CMR		
REVIEW			
CHECKED			
DATE			
SHEET			