Professional Engineering Consultants, P.A.
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Subway Addition
Wichita, Sedgwick County, Kansas
11/18/02

Subway Addition is a 2.25 acre development proposed to consist of a strip of five offices or restaurants, an area for future office buildings, and parking lots. The drainage plan and supporting calculations are presented herein.

Hydrology

The proposed plat lies in the NW ¼, NW ¼, Section 33, T27S, R2E of the 6th P.M. The soil on-site is Irwin silty clay loam and is classified in hydrologic group D. The existing landscape contains several trees, a house, and an abandoned septic field. The site drains to its west end and then flows north along the eastside of Webb Road. A ditch inlet and a curb inlet, which are part of the Webb Road Storm Water Sewer, exist by the northwest corner of the site.

Due to the small size of the site, the nature of its borders, and the contour of the land, the basin used for runoff calculations was the 2.25 acre site. However, it should be noted that the area comprising the Subway Addition was contained in a previous drainage study done by MKEC (Mid-Kansas Engineering Consultants, Inc.) for the Webb Road Improvements. The MKEC study is referenced in this report and was used to analyze the adequacy of Webb Road and its Storm Water Sewer to handle the small runoff increase due to development of the Subway Addition.

The plat runoff, calculated using the Rational Method, for existing conditions is 11.3 CFS for the 100-year storm. Under proposed conditions the runoff increases only 2.0 cfs to be 13.3 cfs. Using the MKEC Webb Road Improvement Plans, it was determined that Webb Road can adequately handle the 2.0 cfs increase. Therefore, detention storage is not required.

Runoff coefficients were estimated based on land use and the tables presented in the Design Aids section. A drainage map and supporting calculations are enclosed in this report. The analysis made is based on the available site data which includes the following: 1"=30' topographic map with 1' contours of the site and adjacent areas, 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, 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.

The storm sewer for the Subway Addition has not yet been designed. However, an analysis was performed in order to determine if the existing Webb Road SWS can handle the 2-year storm runoff from the plat under developed conditions.

Hydraulic analysis of the existing ditch inlet by the northwest corner of the plat 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. Two analyses were performed—the first for existing conditions and the second for the developed condition's 2-year storm increase. Both analyses are included in this report. The results demonstrated that the SWS can adequately handle the site's 2-year storm runoff under developed conditions.

Design Aids

This section includes material used to assist in designing and/or analyzing the drainage system. A 1"=30' 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.

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.

Webb Road from Pawnee Avenue to Harry Street, Proj. No. 87 STP-N-0126-01, MKEC Engineering Consultants, Inc., Wichita, KS, 1999.

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Project SUBWAY Date

Item DRAINAGE STUDY By

I LOCATION

NW¼, NW¼, SEC 33 T27S, R2E

EAST OF WEBB ROAD, SOUTH OF WEBB ROAD ADDITION

II EXISTING CONDITIONS

THE SITE CONTAINS SEVERAL TREES, A HOUSE, AND AN ABANDONED SEPTIC FIELD.

THE SITE DRAINS TO THE WEST END OF THE SITE AND THEN FLOWS NORTH ALONG THE EASTSIDE OF WEBB ROAD. A DITCH INLET AND A CURB INLET EXIST BY THE NORTHWEST CORNER OF THE SITE.

III PROPOSED CONDITIONS

THE PROPOSED CONDITIONS CONSIST OF A STRIP OF FIVE OFFICES OR RESTAURANTS, AN AREA FOR FUTURE OFFICE BUILDINGS, AND PARKING LOTS.

IV SOIL TYPE

Ia = IRWIN
HYDROLOGIC GROUP "D"

V TIME OF CONCENTRATION FOR EXISTING CONDITIONS

DISTANCE = 505'

VELOCITY (ATTACHMENT E)
SHORT GRASS PASTURE OR LAWNS, S = 1.7% → VEL = 0.91 F/s

$$T_c = \frac{DIST}{VEL} = \frac{505'}{0.91F} \left| \frac{SEC}{60SEC} \right| \frac{1\,MIN}{} = 9.2\,MIN < 15\,MIN$$

∴ USE MINIMUM T_c = 15 MIN

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VI FIND FLOW RATES USING RATIONAL METHOD, $Q = CiA$

A. EXISTING CONDITIONS

1. AREA = 2.25 Ac
   - ↳ 1.0 Ac SINGLE FAM. RES "D"
   - ↳ 1.25 Ac SOIL GROUP "D", 1-4%, URBAN LAWN AREAS

2. RUNOFF COEFFICIENTS, C

URBAN LAWN S=1-4%, "D"	RESIDENTIAL, SINGLE FAM 1Ac LOTS, "D"
$C_2 = 0.30$	$C_2 = 0.41$
$C_{100} = 0.65$	$C_{100} = 0.71$

$C_2 = {}^{1.25}/_{2.25}(0.30) + {}^{1.0}/_{2.25}(0.41) = 0.35$

$C_{100} = {}^{1.25}/_{2.25}(0.65) + {}^{1.0}/_{2.25}(0.71) = 0.68$

3. INTENSITY, i

@ $T_C = 15$ MIN: $i_2 = 3.8$ IN/HR
$i_{100} = 7.4$ IN/HR

4. $Q_2 = C_2 i_2 A = 0.35(3.8\text{ IN/HR})(2.25\text{ Ac}) = 3.0$ CFS

$Q_{100} = C_{100} i_{100} A = 0.68(7.4\text{ IN/HR})(2.25\text{ Ac}) = 11.3$ CFS

B. PROPOSED CONDITIONS

1. AREA = 2.25 Ac

2. RUNOFF COEFFICIENTS
   BUSINESS: NEIGHBORHOOD AREAS
   $C_2 = 0.68$
   $C_{100} = 0.80$

3. ASSUME MIN. $T_C = 15$ MIN
   @ $T_C = 15$ MIN: $i_2 = 3.8$ IN/HR
   $i_{100} = 7.4$ IN/HR

4. $Q_2 = C_2 i_2 A = 0.68(3.8\text{ IN/HR})(2.25\text{ Ac}) = 5.8$ CFS

$Q_{100} = C_{100} i_{100} A = 0.80(7.4\text{ IN/HR})(2.25\text{ Ac}) = 13.3$ CFS

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VII RESULTS

EXISTING COND.
$Q_2 = 3.0$ CFS
$Q_{100} = 11.3$ CFS

DEVELOPED COND.
$Q_2 = 5.8$ CFS
$Q_{100} = 13.3$ CFS

$Q_{DEV.} > Q_{EXIST.}$

∴ ANALYZE EXISTING SYSTEM TO DETERMINE IF IT CAN HANDLE THE Q INCREASE

2-YEAR STORM

EXISTING SUBWAY ADDITION AREA DRAINS TO A DITCH INLET WHICH IS AN EXTENSION OF THE WEBB RD. SWS. REFER TO MKEC DRAINAGE STUDY FOR WEBB ROAD IMPROVEMENTS.
* MKEC SWS DESIGNED TO HANDLE 5-YR STORM

BASIN C100a (MKEC) TO DITCH INLET (MKEC INLET 25A)
$A = 3.87$ Ac. (2.25 Ac IS SUBWAY ADDITION)
$C_5 = 0.48$ $C_{100} = 0.72$
$i_5 = 3.43$ IN/HR $i_{100} = 7.18$ IN/HR
$Q_5 = 6.37$ CFS $Q_{100} = 20.01$ CFS

FIND CONTRIBUTION FROM SUBWAY SITE:
$Q_5 = 0.48(2.25\text{ Ac})(3.43\text{ IN/HR}) =$ **3.7 CFS FROM SUBWAY AREA TO DITCH INLET**

ASSUME SUBWAY SITE SWS WILL BE DESIGNED TO HANDLE THE 2-YR STORM. THEREFORE, UNDER DEVELOPED CONDITIONS:

$Q_{INCREASE} = Q_{2DEV} - Q_{SSUBWAYEXIST}$

$Q_{INCREASE} = 5.8\text{ CFS} - 3.7\text{ CFS} = 2.1\text{ CFS}$

∴ $Q_{DITCH\ INLET\ DEV.} = Q_{EXIST\ TO\ INLET} + Q_{INCREASE}$

$Q_{DITCH\ INLET\ DEV.} = 6.37\text{ CFS} + 2.1\text{ CFS} =$ **8.47 CFS**

* RUN STORM ANALYSIS TO CHECK CAPACITY
↳ OK ✓

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100-YEAR STORM

WEBB ROAD HAS BEEN DESIGNED TO CARRY THE 100-YR STORM.

UNDER DEVELOPED CONDITIONS FOR THE SUBWAY ADDITION THE Q_{100} INCREASE IS **2 CFS.**

$Q_{100\,INCREASE} = Q_{100\,DEV} - Q_{100\,EXIST}$

$Q_{100\,INCREASE} = 13.3\,CFS - 11.3\,CFS = 2\,CFS$

REFER TO MKEC DRAINAGE STUDY FOR WEBB RD. IMPROVEMENTS.

SUBWAY ADDITION PART OF BASIN C6Ea (MKEC).

BASINS C1-C6 ENCOMPASS THE FLOW CARRIED BY WEBB ROAD NORTH TO THE HARRY + WEBB INTERSECTION.

C1-C6 Q_{100} = **91.24 CFS** (MKEC)

UNDER DEVELOPED CONDITIONS FOR SUBWAY ADDITION

NEW TOTAL Q_{100} = 91.24 CFS + 2.0 CFS = **93.24 CFS**

CHECK WEBB ROAD CAPACITY (SEE DESIGN AIDS)

$Q_{MAX} = 1737.4\sqrt{.004} = 109.9\,CFS$

($S = 0.4\%$; $S_x = 3/8"/1"$, STANDARD CURB)

$\therefore\ Q_{100} = 93.24\,CFS < Q_{MAX} = 109.9\,CFS$ SO OK ✓

VIII CONCLUSION

THE EXISTING WEBB RD CAN HANDLE THE SMALL INCREASE IN Q FOR DEVELOPED CONDITIONS OF THE SUBWAY ADDITION.

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STORM ANALYSIS

DITCH INLET #25A (MKEC)
TOP = 173^{39}
18" RCP x 19.0' (W)
FE$_{OUT}$ = 171^{36}

DITCH INLET CONNECTED TO CURB INLET #25 (MKEC)
FE = 170^{60} (18" RCP EXTENDED NW)
* ASSUME PIPE FLOWING FULL FOR ANALYSIS
∴ HGL = 170^{60} + 1.5' = 172^{10}

```
100 j,  172.1000  100  1      2     1
110 t,  Subway ditch drain (existing conditions)

120 m,  100   172.1000
131 i,  110      0.48      3.87      0.00      0.00      6.37     15.00    173.39
460 p,  110  100    19.00   18  0.013   0.00    0.00
790 e
```

STORM11.OUT

Date: 11-15-2002
Time: 09:45:20

Subway ditch drain (existing conditions)

Input File: subway.inp

Storm Frequency = 5-Year

* * * H Y D R O L O G Y * * *

Tributary Area								Hydrology Summation				Conduit Data				
Node	to Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC(0) (Min)	I(0) (In/Hr)	Q(0) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
110	100	.48	3.87	.00	.0	15.00	4.56	6.37	15.00	4.56	6.37	6.37	18"	3.60	19.00	.09	15.09

STORM12.OUT

Date: 11-15-2002
Time: 09:45:20

Subway ditch drain (existing conditions)

Input File: subway.inp

Storm Frequency = 5-Year

* * * H Y D R A U L I C S * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
100	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	172.1000	172.1000	.00
110	.00218	.0413	.0000	.0000	.0000	.0000	.0000	.0413	172.1413	173.3900	1.25

```
100 j,  172.1000  100  1      2     1
110 t,  Subway ditch drain (developed conditions)

120 m,  100   172.1000
131 i,  110     0.68     3.87     0.00     0.00     8.47    15.00   173.39
460 p,  110  100    19.00   18  0.013   0.00   0.00
790 e
```

STORM11.OUT

Date: 11-15-2002
Time: 09:49:20

Subway ditch drain (developed conditions)

Input File: subway2.inp

Storm Frequency = 5-Year

* * * H Y D R O L O G Y * * *

Tributary Area								Hydrology Summation				Conduit Data				
Node	to Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC(0) (Min)	I(0) (In/Hr)	Q(0) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
110	100	.68	3.87	.00	.0	15.00	4.56	8.47	15.00	4.56	8.47	8.47	18"	4.79	19.00	.07	15.07

STORM12.OUT

Date: 11-15-2002
Time: 09:49:20

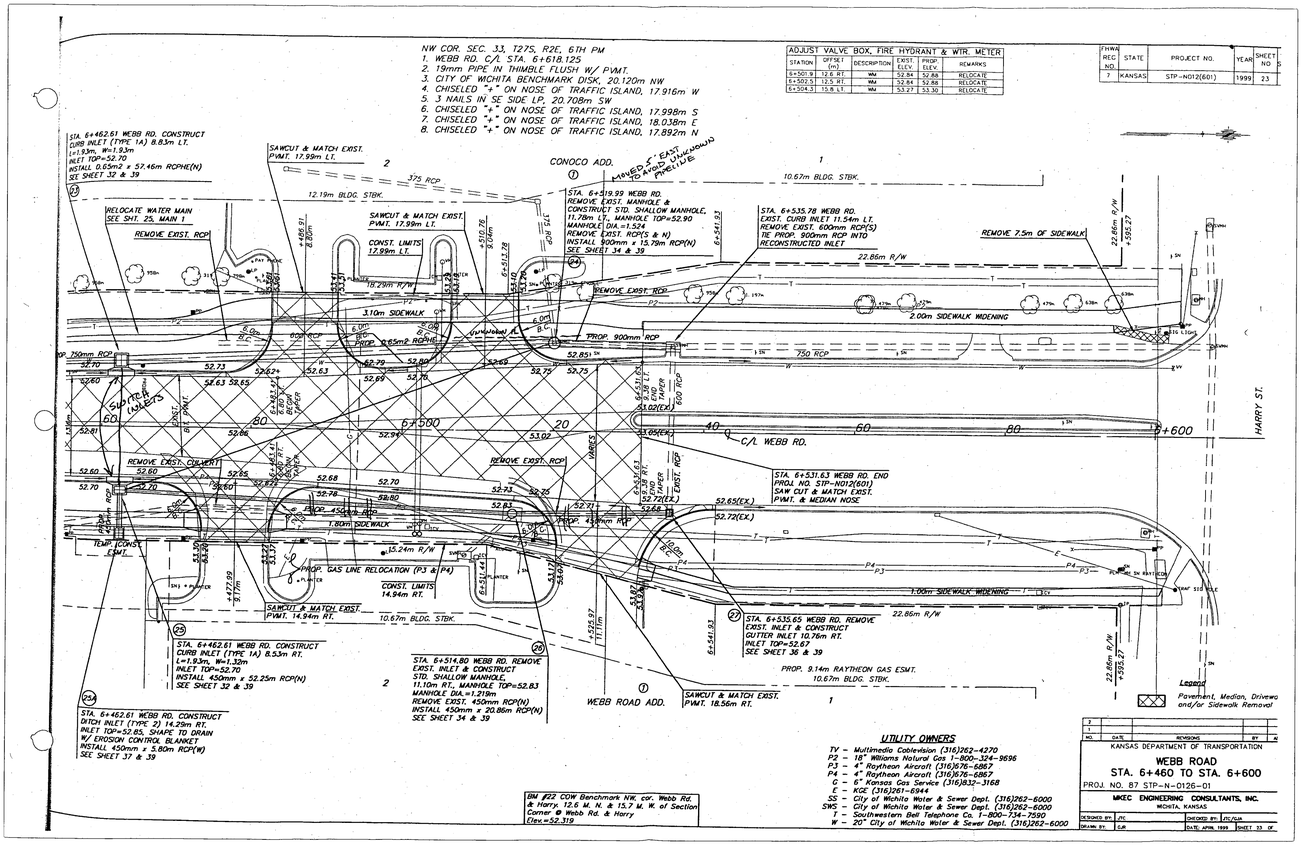
Subway ditch drain (developed conditions)

Input File: subway2.inp

Storm Frequency = 5-Year

* * * H Y D R A U L I C S * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
100	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	172.1000	172.1000	.00
110	.00385	.0731	.0000	.0000	.0000	.0000	.0000	.0731	172.1731	173.3900	1.22



ADJUST VALVE BOX, FIRE HYDRANT & WTR. METER					
STATION	OFFSET (m)	DESCRIPTION	EXIST. ELEV.	PROP. ELEV.	REMARKS
6+501.9	12.6 RT.	WM	52.84	52.88	RELOCATE
6+502.5	12.5 RT.	WM	52.84	52.86	RELOCATE
6+504.3	15.8 LT.	WM	53.27	53.30	RELOCATE

FHWA REC NO.	STATE	PROJECT NO.	YEAR	SHEET NO.
7	KANSAS	STP-N012(601)	1999	23

UTILITY OWNERS

TV – Multimedia Cablevision (316)262-4270
P2 – 18" Williams Natural Gas 1-800-324-8696
P3 – 4" Raytheon Aircraft (316)676-6867
P4 – 4" Raytheon Aircraft (316)676-6867
C – 6" Kansas Gas Service (316)832-3168
E – KGE (316)261-6944
SS – City of Wichita Water & Sewer Dept. (316)262-6000
SWS – City of Wichita Water & Sewer Dept. (316)262-6000
T – Southwestern Bell Telephone Co. 1-800-734-7580
W – 20" City of Wichita Water & Sewer Dept. (316)262-6000

NO.	DATE	REVISIONS	BY
3			
2			
1			

KANSAS DEPARTMENT OF TRANSPORTATION

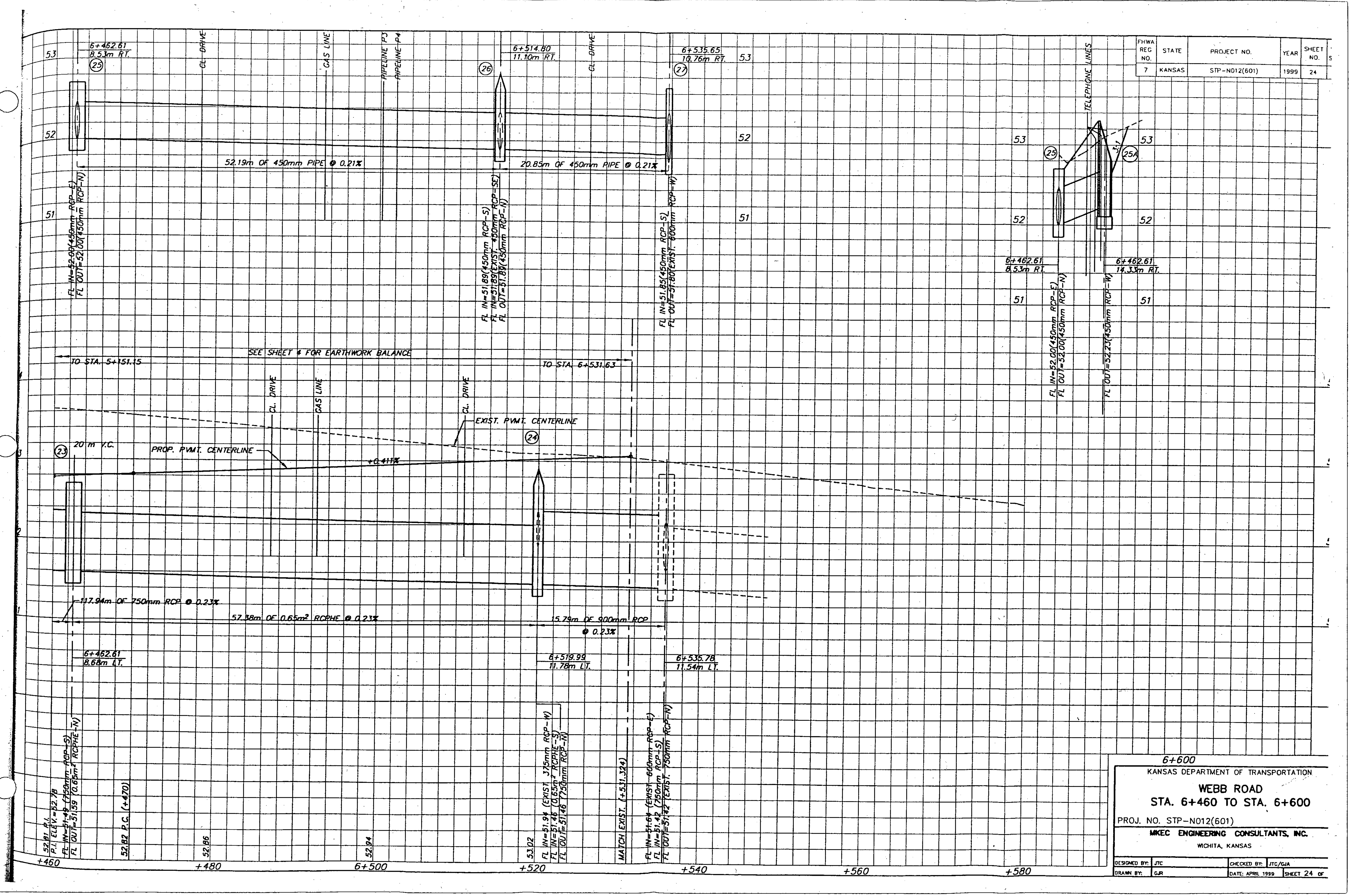
WEBB ROAD
STA. 6+460 TO STA. 6+600

PROJ. NO. 87 STP-N-0126-01

MKEC ENGINEERING CONSULTANTS, INC.
WICHITA, KANSAS

DESIGNED BY: JTC	CHECKED BY: JTC/JLH
DRAWN BY: SLR	DATE: APRIL 1999 SHEET 33 OF

FHWA REG NO.	STATE	PROJECT NO.	YEAR	SHEET NO.	S
7	KANSAS	STP-N012(601)	1999	24	



6+600

KANSAS DEPARTMENT OF TRANSPORTATION

WEBB ROAD
STA. 6+460 TO STA. 6+600

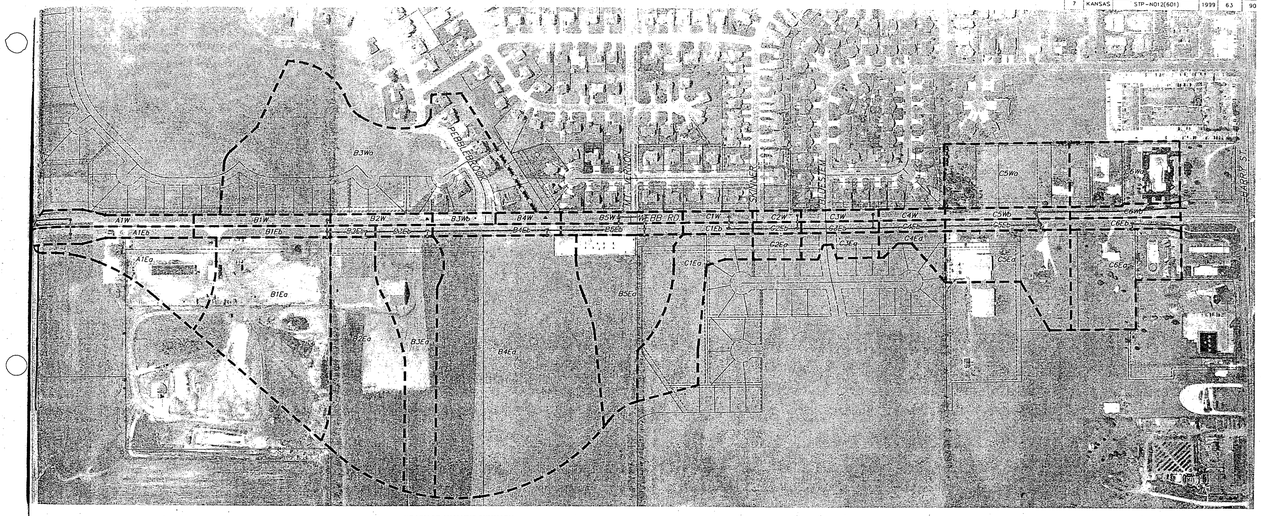
PROJ. NO. STP-N012(601)

MKEC ENGINEERING CONSULTANTS, INC.
WICHITA, KANSAS

DESIGNED BY:	JTC	CHECKED BY:	JTC/GJA
DRAWN BY:	GJR	DATE: APRIL 1999	SHEET 24 OF

FHWA REG NO	STATE	PROJECT NO.	YEAR	SHEET NO	TOT SHEE
7	KANSAS	STP-N012(601)	1999	63	90

SCALE= 1 : 2000



DRAINAGE ANALYSIS SUMMARY
WEBB ROAD IMPROVEMENTS: PAWNEE TO HARRY

Area ID**	Classification	Area	Accum. Area	CS	C100	Flow	Flow	Tc5	Tc100	Tc5	Tc100	I5	I100	Q5	Q100	Inlet Size	Pipe Size	Min Slope	COMMENTS
		ac	ac			Length	Slope	Calc	Calc	min	min	in/hr	in/hr	cfs	cfs	ft	in	%	
A: S. of Pawnee N. to Co. Yard Drive																			
A1Eb: Co Yd Dr. S. to Pawnee	Light Industrial	3.27		0.69	0.80	650.00	0.00462	24.35	17.81	24	18	3.65	7.00	8.25	18.33				
A1Eb: E Right of Way	ROW	1.05		0.69	0.80	540.00	0.00644	22.47	16.44	22	16	3.81	7.18	2.76	8.03				
A1E			4.324	0.69	0.80	650.00	0.00462	24.35	17.81	24	18	3.65	7.00	10.89	24.21				In sump along scool lane
A1W: Co Yd Dr. S. to Pawnee	ROW	0.96		0.69	0.80	540.00	0.00644	22.47	16.44	22	16	3.81	7.18	2.52	5.51				Grade to Pawnee System
Total Watershed A			5.283	0.69	0.80	1560.00	0.01282	26.83	19.63	27	20	3.50	6.68	12.79	28.23				
B: Co. Yard Drive N to Mt. Vernon																			
B1W: West ROW to N. Side Co. Yard	ROW	0.68		0.69	0.80	591.00	0.01523	15.59	11.41	16	15	4.56	7.37	2.14	4.02	5	450	0.40%	
B1Eb: N. portion of Co. Yard	Light Industrial	8.33		0.69	0.80	890.00	0.01461	19.40	14.20	19	15	4.10	7.37	23.56	49.10	Ditch Inlet	600		Grade for Co. Maint. Discharge Pipe
B1Eb: East Right of Way	ROW	0.68		0.69	0.80	591.00	0.01523	15.59	11.41	16	15	4.56	7.37	2.14	4.01	5			
B1E			9.008	0.69	0.80	890.00	0.01461	19.40	14.20	19	15	4.10	7.37	25.48	53.11				

(CONTINUED ON NEXT SHEET)

TOTAL DRAINAGE AREA = 361598 sq. m

DRAINAGE AREA OUTSIDE OF 183m BOUNDARY = 73222 sq. m

NO.	DATE	REVISIONS	BY	APP'D
2				
1				

KANSAS DEPARTMENT OF TRANSPORTATION

WEBB ROAD
DRAINAGE PLAN

PROJ. NO. 87 STP-N-0126-01 SEDGWICK COUNTY

MKEC ENGINEERING CONSULTANTS, INC.
WICHITA, KANSAS

DESIGNED BY:	RW	CHECKED BY:	JTC/GJA
DRAWN BY:	GJA	DATE: APRIL 1999	SHEET 63 OF 90

DRAINAGE ANALYSIS SUMMARY
WEBB ROAD IMPROVEMENTS: PAWNEE TO HARRY (CONTINUED)

B1E + B1W			9.689	0.69	0.80	890.00	0.01348	19.93	14.58	20	15	4.10	7.37	27.41	57.13		600	0.20%	
B2Ea: Community Church [2] Drive S.	Schools	6.68		0.51	0.66	1150.00	0.01304	32.96	24.58	33	25	3.10	6.01	10.56	26.50	Ditch Inlet	600		Provide inlet behind curb for off-site flow
B2Eb: East Right of Way	ROW	0.22		0.69	0.80	170.00	0.01471	8.46	6.19	15	15	4.56	7.37	0.69	1.29	5			
B2E			6.900	0.52	0.66	1150.00	0.01391	31.95	23.82	32	24	3.19	6.13	11.35	28.10				
B1E - B2E + B1W			16.589	0.62	0.71	1150.00	0.01565	25.37	20.46	25	20	3.57	6.53	36.57	76.99		750	2.00%	
B3Ea: Community Church [2] N.	Schools	4.66		0.51	0.66	1150.00	0.01565	31.02	23.13	31	23	3.19	6.13	7.58	18.85	Ditch Inlet	600		Provide inlet behind curb for off-site flow
B3Eb: East Right of Way	ROW	0.29		0.69	0.80	250.00	0.01400	10.43	7.63	15	15	4.56	7.37	0.90	1.68	5			
B3E			4.946	0.52	0.67	1150.00	0.01913	28.50	21.24	29	21	3.37	6.39	8.67	21.11				
B1E - B3E + B1W			21.535	0.60	0.70	1400.00	0.01571	29.24	23.12	29	23	3.30	6.13	42.30	92.53		900	0.76%	
B4Ea: Vacant Parcel [3]	HSG "D" 1-4%	16.62		0.35	0.65	1560.00	0.01282	49.08	29.45	49	29	2.44	5.49	14.19	59.31	Ditch Inlet	600		Provide inlet behind curb for off-site flow
B4Eb: East Right of Way	ROW	0.64		0.69	0.80	560.00	0.01429	15.51	11.35	16	15	4.56	7.37	2.01	3.77	5			
B4E			17.260	0.36	0.66	1560.00	0.01282	48.26	29.09	48	29	2.47	5.49	15.46	62.12				
B1E - B4E + B1W			38.795	0.49	0.68	1800.00	0.01222	43.45	29.94	43	30	2.64	5.49	50.36	144.99		900	1.10%	
B5Ea: Brentwood Village Gardens	Composite 1	5.12		0.68	0.83	850.00	0.01529	19.13	12.30	19	15	4.10	7.37	14.28	31.33	Ditch Inlet	600		Provide inlet behind curb for off-site flow
B5Eb: East Right of Way	ROW	0.61		0.69	0.80	260.00	0.01346	10.78	7.89	15	15	4.56	7.37	1.91	3.57	5			
B5E			5.728	0.68	0.83	850.00	0.01529	19.08	12.44	19	15	4.10	7.37	15.99	34.90				Discharge to Mt. Vernon System
B1E - B5E + B1W			44.522	0.52	0.70	1800.00	0.01222	41.71	28.60	42	29	2.72	5.59	62.50	174.10		900	1.10%	Cross Webb to Mt Vernon System
B2W: West ROW to N of B3Ea	ROW	0.50		0.69	0.80	410.00	0.01463	13.16	9.63	15	15	4.56	7.37	1.59	2.98	5	900		Existing Webb St. System
B3Wa: Pebblebrook Local System	SF "D" 1/3 ac	13.18		0.50	0.73	1300.00	0.01385	34.94	21.54	35	22	3.01	6.39	19.83	61.47				Existing Local System
B3Wb: W. ROW to N. of Pebblebrook	ROW	0.31		0.69	0.80	200.00	0.01500	9.12	6.67	15	15	4.56	7.37	0.98	1.84				To Pebblebrook Sump Area
B3W			13.490	0.50	0.73	1300.00	0.01385	34.68	21.45	35	21	3.01	6.39	20.48	63.07				
B2-3W			13.995	0.51	0.73	1300.00	0.01385	34.29	21.31	34	21	3.01	6.39	21.53	65.65		900		Existing System
B4W: W. ROW to N. of Mt. Vernon	ROW	0.33		0.69	0.80	280.00	0.01071	12.07	8.83	15	15	4.56	7.37	1.03	1.92	5			Existing System
B2-4W			14.322	0.52	0.74	1580.00	0.01266	38.68	24.10	39	24	2.84	6.01	20.95	63.31		900		Existing System
B5W	ROW	0.61		0.69	0.80	275.00	0.01091	11.89	8.70	15	15	4.56	7.37	1.91	3.57				Existing System
B2-5W			14.927	0.52	0.74	1850.00	0.01351	40.46	25.34	40	25	2.76	5.90	21.52	65.02		900		Existing System
Combined Watershed B			59.450	0.52	0.71	1850.00	0.01351	40.78	27.36	41	27	2.76	5.69	84.93	239.92		900		To Mt. Vernon System
C: Mt. Vernon N. to Harry																			
C1Ea: Brntwd V. Gardens N. to Skinner	SF "D" 1/4 ac	3.58		0.51	0.68	900.00	0.01000	31.86	22.68	32	23	3.19	6.26	5.82	15.23				
C1Eb: East Right of Way	ROW	0.35		0.69	0.80	200.00	0.01000	10.44	7.64	15	15	4.56	7.37	1.09	2.04				
C1E			3.925	0.53	0.69	900.00	0.01000	31.00	22.11	31	22	3.19	6.26	6.58	16.97	10			Flow over curb assumed
C1W: W. Right of Way	ROW	0.35		0.69	0.80	200.00	0.01000	10.44	7.64	15	15	4.56	7.37	1.09	2.04	5	450		
C1			4.272	0.54	0.70	900.00	0.01000	30.28	21.63	30	22	3.24	6.39	7.46	19.09		600	0.40%	
C2Ea: Skinner N.	SF "D" 1/4 ac	0.55		0.51	0.68	230.00	0.01000	16.11	11.47	16	15	4.43	7.37	1.23	2.73				
C2Eb: East Right of Way	ROW	0.24		0.69	0.80	200.00	0.01000	10.44	7.64	15	15	4.56	7.37	0.78	1.42				
C2E			0.786	0.57	0.72	230.00	0.01000	14.60	10.46	15	15	4.56	7.37	2.02	4.15	5			Flow over curb assumed
C2W: W. Right of Way	ROW	0.24		0.69	0.80	200.00	0.01000	10.44	7.64	15	15	4.56	7.37	0.76	1.42	5	450		
C2			1.026	0.59	0.74	230.00	0.01000	13.81	9.93	15	15	4.56	7.37	2.78	5.57				
C1+C2			5.297	0.55	0.71	1230.00	0.01000	34.73	24.84	35	25	3.01	6.01	8.77	22.50		24	0.40%	
C3Ea: Circa Bluestem	SF "D" 1/4 ac	0.79		0.51	0.68	310.00	0.01000	18.70	13.31	19	15	4.20	7.37	1.68	3.94				
C3Eb: East Right of Way	ROW	0.39		0.69	0.80	310.00	0.01000	12.99	9.51	15	15	4.56	7.37	1.21	2.27	5			Flow over curb assumed
C3E			1.171	0.57	0.72	310.00	0.01000	16.82	12.06	17	15	4.43	7.37	2.95	6.21				
C3W: W. Right of Way	ROW	0.39		0.69	0.80	310.00	0.01000	12.99	9.51	15	15	4.56	7.37	1.21	2.27	5	450	0.40%	
C3			1.557	0.60	0.74	310.00	0.01000	15.87	11.43	16	15	4.56	7.37	4.25	8.48				
C1 - C3			6.854	0.56	0.71	1590.00	0.01000	38.68	27.70	39	28	2.84	5.69	10.92	27.85		600	0.50%	
C4Ea: S. of Bapt. Church Drive	1/2 ac SF "D"	0.69		0.48	0.72	280.00	0.01000	18.67	11.45	19	15	4.20	7.37	1.40	3.68				
C4Eb: East Right of Way	ROW	0.33		0.69	0.80	280.00	0.01000	12.35	9.04	15	15	4.56	7.37	1.03	1.93				
C4E			1.020	0.55	0.75	280.00	0.01000	16.65	10.67	17	15	4.43	7.37	2.47	5.61	5			Flow over curb assumed
C4W: W. Right of Way	ROW	0.33		0.69	0.80	280.00	0.01000	12.35	9.04	15	15	4.56	7.37	1.03	1.93	5	450	0.40%	
C4			1.348	0.58	0.76	280.00	0.01000	15.60	10.28	16	15	4.56	7.37	3.58	7.54				
C1 - C4			8.202	0.56	0.72	1670.00	0.01000	41.68	29.47	42	29	2.72	5.49	12.59	32.48		600	0.50%	
C5Ea: Bapt. Church Drive N. to High Point	1/2 ac SF "D"	3.60		0.48	0.72	500.00	0.01000	24.95	15.29	25	15	3.65	7.37	6.30	19.09	Ditch Inlet	600		Provide inlet behind curb for off-site flow
C5Eb: East Right of Way	ROW	0.63		0.69	0.80	430.00	0.01000	15.30	11.20	15	15	4.56	7.37	1.97	3.70	5			
C5E			4.225	0.51	0.73	500.00	0.01000	23.70	14.82	24	15	3.73	7.37	8.06	22.79				
C5Wa: Bapt. Church Drive N. to High Point	SF 1/3 ac "D"	3.52		0.50	0.73	650.00	0.01000	27.53	16.98	28	17	3.43	7.18	6.05	18.47	Ditch Inlet	600		Provide inlet behind curb for off-site flow
C5Wb: West Right of Way	ROW	0.63		0.69	0.80	430.00	0.01000	15.30	11.20	15	15	4.56	7.37	1.97	3.70	5			
C5W			4.152	0.53	0.74	650.00	0.01000	26.22	16.49	26	16	3.50	7.18	7.68	22.08				
C5			8.377	0.52	0.74	650.00	0.01000	26.62	16.70	27	17	3.50	7.18	15.24	44.28				
C1 - C5			16.578	0.54	0.73	2230.00	0.01000	47.44	31.55	47	32	2.50	5.32	22.46	64.28		900	0.30%	Clearance inadequate
C6Ea: North End of Project	1/2 ac SF "D"	3.87		0.48	0.72	610.00	0.01000	27.56	16.89	28	17	3.43	7.18	6.37	20.01	Ditch Inlet	600		
C6Eb: East Right of Way	ROW	0.56		0.69	0.80	260.00	0.01000	11.90	8.71	15	15	4.56	7.37	1.76	3.29				
C6E			4.428	0.51	0.73	610.00	0.01000	26.39	16.45	26	16	3.50	7.18	7.85	23.21		600	0.21%	
C6Wa: North End of Project	SF 1/3 ac "D"	3.00		0.50	0.73	610.00	0.01000	26.67	16.45	27	16	3.50	7.18	5.26	15.74				
C6Wb: West Right of Way	ROW	0.61		0.69	0.80	260.00	0.01000	11.90	8.71	15	15	4.56	7.37	1.92	3.59				
C6W			3.612	0.53	0.74	610.00	0.01000	25.25	15.92	25	16	3.57	7.37	6.86	19.75	10			
C6			8.040	0.52	0.74	610.00	0.01000	25.88	16.21	26	16	3.57	7.18	14.87	42.45				
C1 - C6			24.618	0.53	0.73	2630.00	0.01000	52.24	34.06	52	34	2.35	5.07	30.90	91.24		900	0.21%	Discharge to existing 750 mm RCP
Total Area		84.07	84.068																

FHWA REG NO.	STATE	PROJECT NO.	YEAR	SHEET NO
7	KANSAS	STP-N012(601)	1999	64

General Watershed Parameters

Soil Classification	HSG	Avg. Calc.	Estimated % of Tot.
Ia	D	0.6	15
Rd	D	1.72	43
Ta	D	1.68	42
	Avg =		100
	Use HSG		

Runoff Coefficients by Land Use

Classification	Description	C5
ROW		0.69
Light Industrial		0.69
Schools		0.51
SF 1/2 ac "D"		0.48
SF 1/3 ac "D"		0.50
SF 1/4 ac "D"		0.51
MF Attached "D"		0.68
HSG "D" 1-4%		0.35
Composite 1		0.46

Tc Calculated Using City of Wichita Procedure

[1] Watershed "A" Drains to Pawnee System. Provided For Information Only.

[2] Community Church Property Runoff Coefficients from "School"

[3] Vacant Parcel Runoff Coefficient from "Urban Lawn Areas, Type D, Slopes 1% to 4%" Development will require detention

[4] Percent Impervious for ROW Areas Roughly Corresponds with Value for Light Indusrial

NO.	DATE	REVISIONS	BY
2			
1			

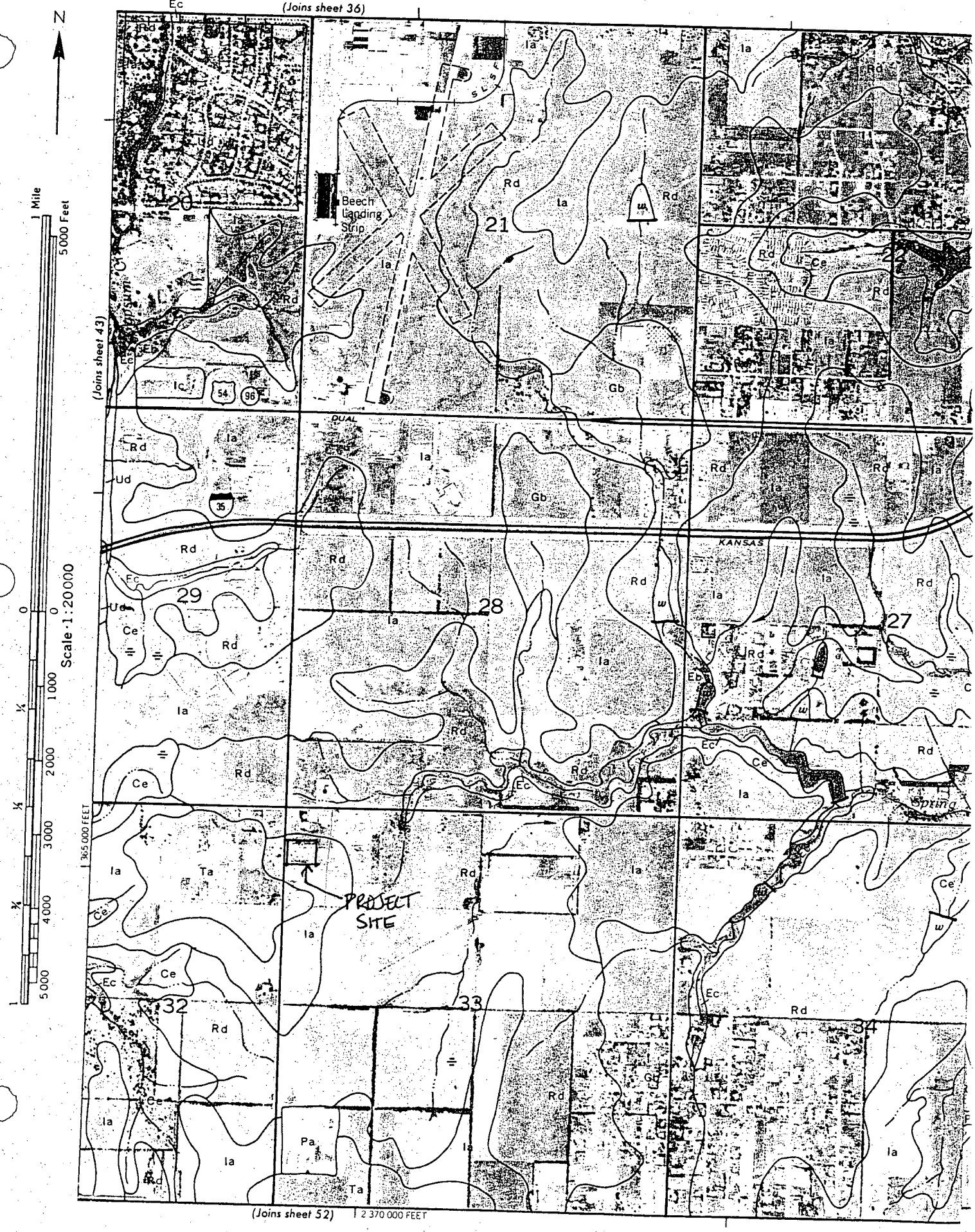
KANSAS DEPARTMENT OF TRANSPORTATION

WEBB RD.
DRAINAGE ANALYSIS SUMMARY

PROJ. NO. 87 STP-N-0126-01 SEDGWICK CO

MKEC ENGINEERING CONSULTANTS, INC.
WICHITA, KANSAS

DESIGNED BY:	TKM	CHECKED BY:	JTC/GJA
DRAWN BY:	GJR	DATE: JUNE 1999	SHEET 64


N
(Joins sheet 36)
(Joins sheet 43)
(Joins sheet 52)
Beech Landing Strip
PROJECT SITE
KANSAS
DUAL
Spring
20
21
22
27
28
29
32
33
34
Scale · 1:20000
1 Mile
5000 Feet
365 000 FEET
2 370 000 FEET

RAINFALL INTENSITY TABLE

SEDGWICK COUNTY KANSAS
(revised June 1997)

This table contains average rainfall intensities in inches per hour.

DURATION, HR:MIN	RETURN PERIOD 1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
0:05	4.91	5.64	6.64	7.38	8.48	9.34	10.20
0:06	4.62	5.34	6.33	7.07	8.15	9.00	9.84
0:07	4.38	5.09	6.08	6.80	7.86	8.69	9.52
0:08	4.17	4.87	5.85	6.56	7.60	8.41	9.22
0:09	4.00	4.68	5.63	6.33	7.34	8.14	8.93
0:10	3.84	4.50	5.43	6.11	7.10	7.87	8.64
0:11	3.70	4.34	5.25	5.90	6.86	7.61	8.36
0:12	3.56	4.19	5.07	5.71	6.64	7.36	8.09
0:13	3.44	4.05	4.91	5.53	6.43	7.14	7.84
0:14	3.33	3.92	4.76	5.36	6.24	6.92	7.61
0:15	3.22	3.80	4.62	5.21	6.06	6.73	7.40
0:16	3.12	3.69	4.49	5.07	5.91	6.56	7.21
0:17	3.03	3.58	4.37	4.94	5.76	6.40	7.04
0:18	2.94	3.48	4.26	4.82	5.63	6.26	6.88
0:19	2.85	3.39	4.16	4.71	5.50	6.12	6.74
0:20	2.77	3.30	4.06	4.60	5.38	5.99	6.60
0:21	2.70	3.22	3.97	4.50	5.27	5.87	6.47
0:22	2.63	3.14	3.88	4.41	5.17	5.76	6.35
0:23	2.56	3.07	3.80	4.32	5.07	5.65	6.23
0:24	2.50	3.00	3.72	4.23	4.97	5.54	6.12
0:25	2.44	2.93	3.64	4.15	4.88	5.44	6.01
0:26	2.38	2.87	3.57	4.07	4.79	5.35	5.90
0:27	2.33	2.81	3.50	4.00	4.70	5.26	5.80
0:28	2.27	2.75	3.44	3.92	4.62	5.17	5.71
0:29	2.23	2.69	3.37	3.86	4.54	5.08	5.61
0:30	2.18	2.64	3.31	3.79	4.47	4.99	5.52
0:31	2.14	2.59	3.26	3.72	4.39	4.91	5.43
0:32	2.09	2.54	3.20	3.66	4.32	4.83	5.34
0:33	2.05	2.50	3.14	3.60	4.25	4.76	5.26
0:34	2.02	2.45	3.09	3.54	4.18	4.68	5.18
0:35	1.98	2.41	3.04	3.48	4.12	4.61	5.10
0:36	1.94	2.37	2.99	3.43	4.05	4.54	5.02
0:37	1.91	2.33	2.94	3.38	3.99	4.47	4.95
0:38	1.88	2.29	2.90	3.32	3.93	4.40	4.87
0:39	1.85	2.25	2.85	3.27	3.87	4.34	4.80
0:40	1.82	2.22	2.81	3.23	3.82	4.28	4.73
0:41	1.79	2.18	2.77	3.18	3.76	4.22	4.67
0:42	1.76	2.15	2.73	3.13	3.71	4.16	4.60
0:43	1.73	2.12	2.69	3.09	3.66	4.10	4.54
0:44	1.71	2.09	2.65	3.05	3.61	4.04	4.48
0:45	1.68	2.06	2.62	3.01	3.56	3.99	4.42
0:46	1.66	2.03	2.58	2.96	3.51	3.94	4.36
0:47	1.63	2.00	2.55	2.93	3.47	3.89	4.30
0:48	1.61	1.97	2.51	2.89	3.42	3.84	4.25
0:49	1.59	1.95	2.48	2.85	3.38	3.79	4.20
0:50	1.57	1.92	2.45	2.81	3.34	3.74	4.15

RAINFALL INTENSITY TABLE

SEDGWICK COUNTY KANSAS
(revised June 1997)

This table contains average rainfall intensities in inches per hour.

DURATION, HR:MIN	RETURN PERIOD 1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
0:51	1.55	1.90	2.42	2.78	3.30	3.70	4.10
0:52	1.53	1.87	2.39	2.75	3.26	3.65	4.05
0:53	1.51	1.85	2.36	2.71	3.22	3.61	4.00
0:54	1.49	1.83	2.33	2.68	3.18	3.57	3.95
0:55	1.47	1.80	2.30	2.65	3.14	3.53	3.91
0:56	1.45	1.78	2.28	2.62	3.11	3.49	3.86
0:57	1.43	1.76	2.25	2.59	3.07	3.45	3.82
0:58	1.41	1.74	2.22	2.56	3.04	3.41	3.78
0:59	1.40	1.72	2.20	2.53	3.01	3.37	3.74
1:00	1.38	1.70	2.17	2.50	2.97	3.34	3.70
1:05	1.30	1.61	2.06	2.38	2.82	3.17	3.52
1:10	1.23	1.53	1.96	2.26	2.69	3.02	3.35
1:15	1.17	1.45	1.87	2.16	2.57	2.89	3.20
1:20	1.11	1.38	1.79	2.06	2.46	2.77	3.07
1:25	1.06	1.32	1.71	1.98	2.36	2.65	2.95
1:30	1.01	1.27	1.64	1.90	2.27	2.55	2.83
1:35	0.97	1.21	1.58	1.83	2.18	2.46	2.73
1:40	0.93	1.16	1.52	1.76	2.10	2.37	2.63
1:45	0.89	1.12	1.46	1.70	2.03	2.29	2.54
1:50	0.86	1.08	1.41	1.64	1.96	2.21	2.46
1:55	0.82	1.04	1.36	1.58	1.89	2.13	2.38
2:00	0.79	1.00	1.31	1.53	1.83	2.07	2.30
2:05	0.76	0.97	1.27	1.48	1.77	2.00	2.23
2:10	0.74	0.93	1.23	1.43	1.72	1.94	2.16
2:15	0.71	0.90	1.19	1.39	1.67	1.88	2.10
2:20	0.69	0.87	1.15	1.35	1.62	1.83	2.04
2:25	0.66	0.85	1.12	1.31	1.57	1.78	1.98
2:30	0.64	0.82	1.09	1.27	1.53	1.73	1.93
2:35	0.62	0.80	1.06	1.24	1.49	1.68	1.88
2:40	0.61	0.78	1.03	1.21	1.45	1.64	1.83
2:45	0.59	0.75	1.01	1.18	1.42	1.60	1.79
2:50	0.57	0.74	0.98	1.15	1.38	1.56	1.74
2:55	0.56	0.72	0.96	1.12	1.35	1.53	1.70
3:00	0.55	0.70	0.94	1.10	1.32	1.49	1.67
3:15	0.51	0.66	0.88	1.03	1.24	1.40	1.57
3:30	0.48	0.62	0.83	0.97	1.17	1.32	1.48
3:45	0.45	0.59	0.78	0.92	1.11	1.26	1.40
4:00	0.43	0.56	0.75	0.88	1.06	1.20	1.34
4:15	0.41	0.53	0.71	0.84	1.01	1.14	1.28
4:30	0.40	0.51	0.68	0.80	0.97	1.10	1.22
4:45	0.38	0.49	0.66	0.77	0.93	1.05	1.17
5:00	0.37	0.47	0.63	0.74	0.89	1.01	1.13
5:15	0.36	0.46	0.61	0.72	0.86	0.98	1.09
5:30	0.35	0.44	0.59	0.69	0.83	0.94	1.05
5:45	0.34	0.43	0.57	0.67	0.81	0.91	1.02
6:00	0.33	0.42	0.55	0.65	0.78	0.88	0.98

(3 pages)

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

RECOMMENDED RUNOFF COEFFICIENTS FOR RATIONAL METHOD
AND PERCENT IMPERVIOUS FOR UNIT HYDROGRAPH METHOD

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
1. Business:					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
2. Residential:					
Single Family (Soil Group D)					
1/8 Acre	50	0.57	0.61	0.66	0.79
1/4 Acre	38	0.50	0.54	0.62	0.76
1/3 Acre	30	0.46	0.50	0.59	0.73
1/2 Acre	25	0.42	0.48	0.56	0.72
3/4 Acre	22	0.42	0.46	0.55	0.71
1 Acre	20	0.41	0.45	0.54	0.71
Multi-Family (Soil Group D)					
Multi-Unit (detached)	60	0.62	0.66	0.72	0.82
Multi-Unit (attached)	65	0.64	0.68	0.73	0.83
Apartments	75	0.70	0.73	0.79	0.86
Single Family (Soil Group C)					
1/8 Acre	50	0.55	0.58	0.64	0.73
1/4 Acre	38	0.48	0.51	0.57	0.68
1/3 Acre	30	0.43	0.46	0.53	0.65
1/2 Acre	25	0.40	0.43	0.50	0.63
3/4 Acre	22	0.39	0.42	0.49	0.62
1 Acre	20	0.37	0.40	0.48	0.61
Multi-Family (Soil Group C)					
Multi-Unit (detached)	60	0.60	0.63	0.69	0.77
Multi-Unit (attached)	65	0.63	0.66	0.71	0.79
Apartments	75	0.68	0.72	0.77	0.83
Single-Family (Soil Group B)					
1/8 Acre	50	0.52	0.54	0.59	0.67
1/4 Acre	38	0.44	0.46	0.52	0.61
1/3 Acre	30	0.39	0.41	0.47	0.57
1/2 Acre	25	0.36	0.38	0.44	0.54
3/4 Acre	22	0.34	0.36	0.42	0.52
1 Acre	20	0.33	0.35	0.40	0.51
Multi-Family (Soil Group B)					
Multi-Unit (detached)	60	0.58	0.60	0.65	0.72
Multi-Unit (attached)	65	0.61	0.64	0.68	0.75
Apartments	75	0.67	0.70	0.74	0.80

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Single Family (Soil Group A)					
1/8 Acre	50	0.47	0.50	0.54	0.60
1/4 Acre	38	0.39	0.41	0.45	0.52
1/3 Acre	30	0.33	0.35	0.39	0.47
1/2 Acre	25	0.30	0.31	0.35	0.44
3/4 Acre	22	0.28	0.29	0.33	0.42
1 Acre	20	0.26	0.28	0.32	0.40
Multi-Family (Soil Group A)					
Multi-Unit (detached)	60	0.55	0.57	0.61	0.67
Multi-Unit (attached)	65	0.58	0.60	0.64	0.70
Apartments	75	0.65	0.68	0.72	0.77
3. Industrial:					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
4. Playgrounds:	15	0.33	0.35	0.42	0.55
5. Schools:	40	0.49	0.51	0.56	0.66
6. Railroad Yard Areas:	30	0.43	0.45	0.50	0.62
7. Undeveloped Urban Areas: Offsite Flow Analysis (when land use not defined)	45	0.52	0.54	0.59	0.68
8. Streets:					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
9. Drive, Parking Lots and Walks:	96	0.87	0.87	0.88	0.89
10. Roofs:	90	0.80	0.85	0.90	0.93
11. Urban Lawn Areas (See Note No. 1 below):					
Soil Group A					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
Soil Group B					
Slope less than 1%	00	0.26	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
Soil Group C					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%.	00	0.28	0.31	0.39	0.55

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Soil Group D					
Slope less than 1%	00	0.28	0.33	0.43	0.63
Slope 1% to 4%	00	0.30	0.35	0.45	0.65
Slope more than 4%	00	0.32	0.37	0.47	0.67

Note No. 1: Coefficients shown in the above table are for pervious open space areas with thick turf which includes pervious areas in parks and cemeteries. Coefficients shown above must be increased 0.02 for use with agricultural pasture areas. Coefficients shown above must be reduced by 0.04 for use with agricultural cultivated areas. Group A soils are well-drained, coarse textured sands with high infiltration rates. Group B soils are moderately well-drained, moderately coarse textured soils with moderate infiltration rates. Group C soils are moderately poor-drained, moderately fine textured soils with slow infiltration rates. Group D soils are poor-drained, fine textured soils with very slow infiltration rates.

GENERAL NOTE: These Rational Formula Coefficients may not be valid for large basins.

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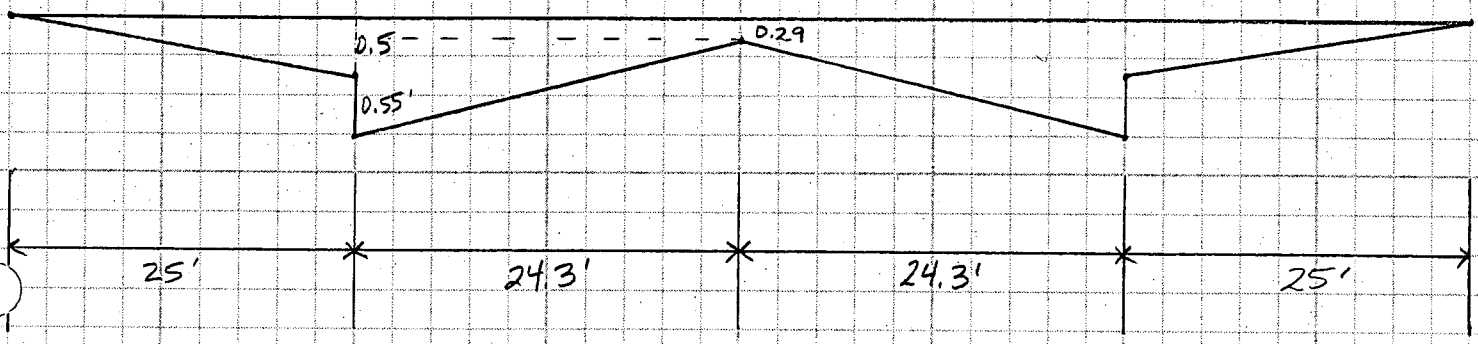
Project _____ Date _____

Item _____ By _____

DETERMINE CAPACITIES OF STANDARD CURB STREETS W/ VARIOUS WALK GRADES FOR 100-YR STORM ANALYSIS

0.5' WALK GRADE



$$n = \frac{(2 \times 24.5 \times 0.03) + (2 \times 3.05 \times 0.013) + (2 \times 22.3 \times 0.016)}{99.7} = 0.02270$$

$$A = (2 \times 1/2 \times 25 \times 0.5) + (48.6 \times 0.29) + (2 \times 1/2 \times 24.3 \times 0.76) = 45.06 \text{ SF}$$

$$P = 99.7'$$

$$R = \frac{A}{P} = \frac{45.06}{99.7} = 0.452$$

$$R^{2/3} = (0.452)^{2/3} = 0.589$$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$Q = \frac{1.486}{0.02270} (45.06)(0.589)(S^{1/2})$$

$$Q = 1737.4\, S^{1/2}$$