21st Street Kids and Family Empowerment
Wichita, Sedgwick County, Kansas
09/19/05

21st Street Kids and Family Empowerment is a 32.05 acre development within the city limits of Wichita in Sedgwick County, Kansas. The 4 lot development consists of streets and storm sewer and was originally platted as part of the Logopedics Addition. This report contains a drawing of the drainage plan, supporting calculations and data for the 21st Street Kids and Family Empowerment Drainage Plan.

Hydrology

The proposed plat lies in the SW 1/4, Section 3, T27S, R1E. The soil on-site is comprised of Urban land – Canadian complex, which is classified in hydrologic group B. The site is currently zoned for multi-family uses and has short grass and pavement throughout. The site is bordered to the north by 25th Street North, to the east by the Audry Matlock Heights Second Addition, to the south by 21st Street North, and to the west by the Wilbers Addition. The existing storm sewer and pavement adjacent to the Cessna Training and Assembly Complex will remain unchanged with these improvements. Basin 1 generally drains to the south to 21st Street North and Basin 2 drains to the south and west to 24th Street North.

Most of the site is in the 100-year floodplain but is protected by a levee, which is subject to possible failure or overtopping during larger floods. A copy of the FEMA Floodway Map for this area is included in the Design Aids section of this report.

The Rational Method was used to calculate runoff quantities. Runoff coefficients were estimated based on tables presented in the Design Aids section of this report using fully developed conditions. Time of concentration was based on slope, flow velocity and length of flow through each basin and was not allowed to be less than 15 minutes. The

HEC-1 computer program was used to route the runoff through the dry detention ponds and determine the proposed conditions leaving the site.

Reserve B will be used as a dry detention basin for the upper reaches of Basin 1. Storm water will surcharge from the storm sewer through two area inlets in this area up to 2.5 feet deep before it spills over into the adjacent streets. A 0.5 acre dry detention area will also be needed on Lot 4, Block 1. It will be controlled by a pair of 18" RCPs and a 5' wide berm with no steeper than 6:1 side slopes. The berm will tie into proposed improvements, which will be possible, since the site will have to be raised to the minimum opening elevation of 135.0. Table 1 summarizes the flows to both 21st Street North (Basin 1) and 24th Street North (Basin 2) for existing and proposed.

Table 1 Summary of Existing and Proposed Runoff Rates

BASIN	STORM EVENT (YR)	EXISTING RUNOFF (CFS)	PROPOSED RUNOFF (CFS)
1	2	64	62
	5	81	79
	10	101	92
	25	122	106
	50	140	121
	100	160	135
2	2	16	15
	5	20	19
	10	26	22
	25	32	24
	50	37	27
	100	43	29

The analysis was made based on the available site data which includes the following: 1" = 100' topographic map with 1' contours of the site, a Sedgwick County Soil Survey Map and noted references.

Storm Sewer Design

In the hydraulic analysis, the storm sewers are typically 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 minor and major 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), pages 5-9. It has been assumed that Tc for street flow is equal to Tc for pipe flow. This is a simplifying, but conservative, assumption since pipe flow velocities generally exceed street flow velocities. For local streets, curb-deep flow is tolerable for the minor storm. For collector streets, a single eight-foot lane should remain unflooded for the minor storm. This site has twenty-one foot back-to-back streets with 3-5/8" roll curb. The crown of the roadway is at the same elevation as the top of curb; therefore, the crown will be under water with curb deep flow.

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.

The existing storm sewer in the Jardine Drive right-of-way is a 15" RCP, which will not be replaced with this project. Note that a 15" RCP can only carry approximately 6 cfs assuming a velocity of 5 ft/s. Since Basin 1 produces approximately 70 cfs with the 2-yr

storm, with no detention, the proposed storm sewer can not be sized for the 2-yr storm. This inadequacy will cause water to surcharge into the streets and parking lots during most storm events providing additional detention storage. Specifically, Lots 1 and 2, Block 1 have 12" RCP extensions which can only handle approximately 4 cfs; therefore, the parking areas on these lots will have to be graded to detain the difference. This additional detention storage is not reflected in the HEC-1 analysis since the size and location of the parking lots are unknown at this time.

Jardine Drive is not capable of carrying the 2-year storm with curb deep flow due to inadequate storm sewer, flat street grades and roll curb. 100-year flow will overtop the curb and be carried within the medians and adjacent open space. 24th Street North, on the other hand, is adequate for the flows directed at it from the proposed improvements.

Design Aids

This section includes material used to assist in designing the drainage system. A 1" = 100' 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.

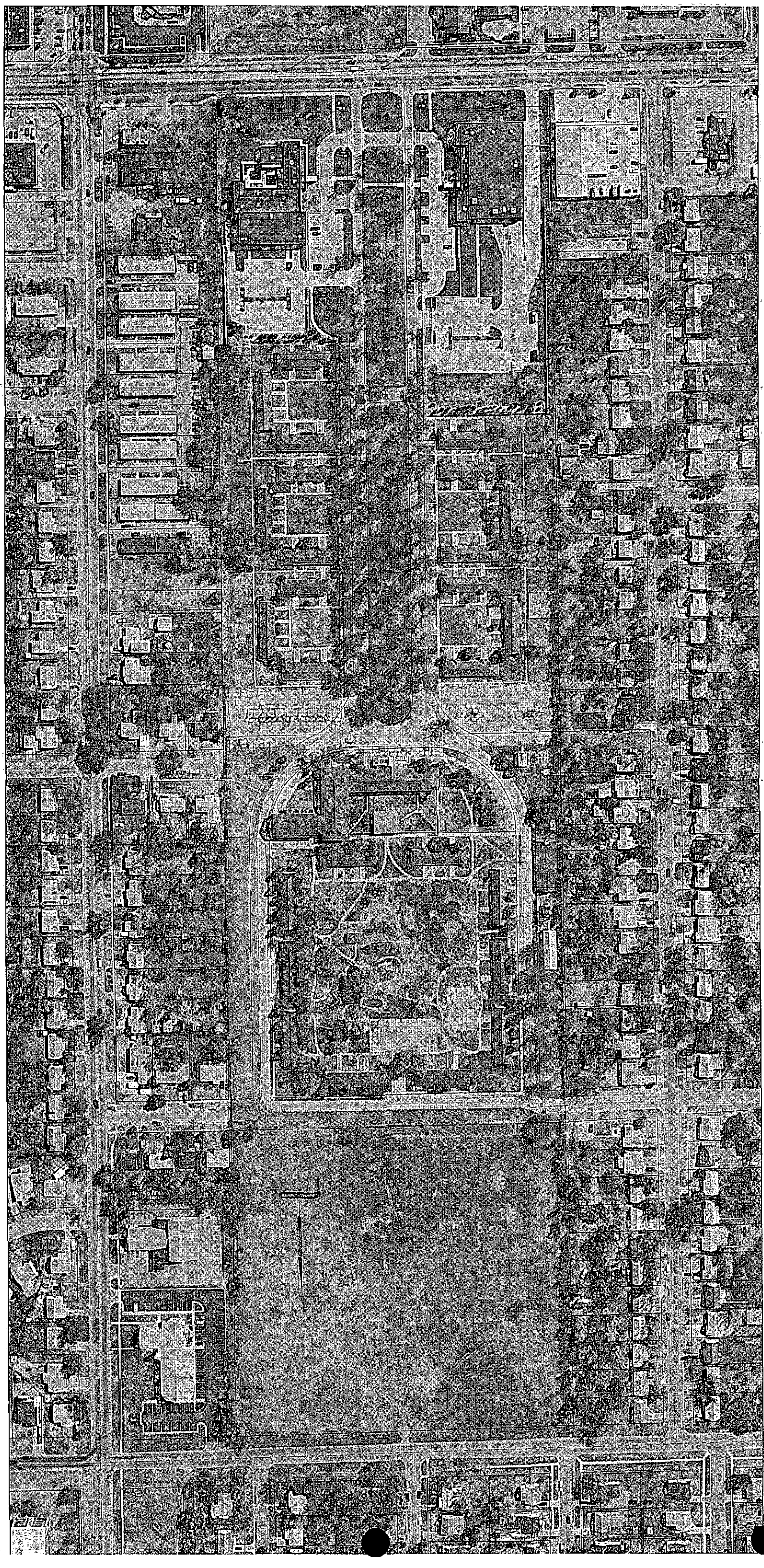
Drainage of Highway Pavements; Hydraulic Engineering Circular #12, by Tye Engineering, Inc., March 1984.

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.

Urban Hydrology for Small Watersheds, US Department of Agriculture, Soil Conservation Service, 1986.

EXISTING CONDITIONS



Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project 21st St Kids By BLB Date 9-16-05

Location Basin 1 Checked ____ Date ____

Circle one: (Present) Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	UPPER	
1. Surface description (table 3-1)			Grass	
2. Manning's roughness coeff., n (table 3-1)			0.030	
3. Flow length, L (total L ≤ 300 ft)	ft		235	
4. Two-yr 24-hr rainfall, P_2	in		3.50	
5. Land slope, s	ft/ft		0.020	
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	Compute T_t	0.09 +	= 0.09

Shallow concentrated flow		Segment ID	MIDDLE	
7. Surface description (paved or unpaved)			Paved	
8. Flow length, L	ft		710	
9. Watercourse slope, s	ft/ft		0.002	
10. Average velocity, V (figure 3-1)	ft/s		1.50	
11. $T_t = \frac{L}{3600\ V}$	hr	Compute T_t	0.13 +	= 0.13

Channel flow		Segment ID	LOWER	
12. Cross sectional flow area, a	ft^2		1.23	
13. Wetted perimeter, p_w	ft		3.93	
14. Hydraulic radius, $r = \frac{a}{p_w}$	ft	Compute r	0.31	
15. Channel slope, s	ft/ft		0.0038	
16. Manning's roughness coeff., n			0.013	
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$	ft/s	Compute V	3.24	
18. Flow length, L	ft		1,345	
19. $T_t = \frac{L}{3600\ V}$	hr	Compute T_t	0.12 +	= 0.12
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr			0.34

Water sheet flows to the street where it is carried in curb to SWS then to 21st St N.

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project 21st St Kids By BLB Date 9-16-05

Location Basin 2 Checked _____ Date _____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	UPPER	
1. Surface description (table 3-1)			grass	
2. Manning's roughness coeff., n (table 3-1)			0.030	
3. Flow length, L (total L ≤ 300 ft)	ft		300	
4. Two-yr 24-hr rainfall, P_2	in		3.50	
5. Land slope, s	ft/ft		0.010	
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.36 +	= 0.36

Shallow concentrated flow		Segment ID	LOWER	
7. Surface description (paved or unpaved)			Unpaved	
8. Flow length, L	ft		610	
9. Watercourse slope, s	ft/ft		0.007	
10. Average velocity, V (figure 3-1)	ft/s		1.40	
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.12 +	= 0.12

Channel flow		Segment ID		
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, p_w	ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft			
15. Channel slope, s	ft/ft			
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s			
18. Flow length, L	ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.48

Project: **21st Street Kids and Family Empowerment**
Date: 9/16/2005
Prep. By: BLB

BASIN 1 - EXISTING CONDITIONS

Total Area 29.02 Acres

Soil Group	**A** (% of Total Area)	**B** (% of Total Area)	**C** (% of Total Area)	**D** (% of Total Area)	**Total**
	0%	100%	0%	0%	100%
Acres	0.00	29.02	0.00	0.00	29.02

Land Use	**Commercial** (% of Total Area)	**Industrial** (% of Total Area)	**Multi-Family** (% of Total Area)	**Public** (% of Total Area)	**Single Family** (% of Total Area)	**Vacant/Agriculture** (% of Total Area)
Existing	0%	0%	80%	0%	20%	0%
Acres	0.00	0.00	23.22	0.00	5.80	0.00

Runoff Coefficients * Used Soil Group D To Be Conservative

Return Period (Years)	**Commercial**	**Industrial**	**Multi-Family**	**Public**	**Single Family**	**Vacant/Agriculture**
2	0.68	0.68	0.70	0.49	0.50	0.54
5	0.69	0.69	0.73	0.51	0.54	0.56
10	0.73	0.73	0.79	0.56	0.62	0.61
25	0.75	0.75	0.81	0.59	0.66	0.64
50	0.77	0.77	0.83	0.62	0.70	0.67
100	0.80	0.80	0.86	0.66	0.76	0.70

Return Period (Years)	**Runoff Coefficient** *	**Rainfall Intensity (in/hr)**	**Area (Acres)**	**Runoff (cfs)**	
2	0.66	3.33	29.02	63.78	
5	0.69	4.00	29.02	80.33	
10	0.76	4.60	29.02	100.92	**Q = CiA**
25	0.78	5.35	29.02	121.10	
50	0.80	6.00	29.02	139.99	
100	0.84	6.53	29.02	159.18	

Project: **21st Street Kids and Family Empowerment**
Date: 9/16/2005
Prep. By: BLB

BASIN 2 - EXISTING CONDITIONS

Total Area 10.88 Acres

Soil Group	**A** (% of Total Area)	**B** (% of Total Area)	**C** (% of Total Area)	**D** (% of Total Area)	**Total**
	0%	100%	0%	0%	100%
Acres	0.00	10.88	0.00	0.00	10.88

Land Use	**Commercial** (% of Total Area)	**Industrial** (% of Total Area)	**Multi-Family** (% of Total Area)	**Public** (% of Total Area)	**Single Family** (% of Total Area)	**Vacant/Agriculture** (% of Total Area)
Existing	0%	0%	0%	0%	20%	80%
Acres	0.00	0.00	0.00	0.00	2.18	8.70

Runoff Coefficients * Used Soil Group D To Be Conservative

Return Period (Years)	**Commercial**	**Industrial**	**Multi-Family**	**Public**	**Single Family**	**Vacant/Agriculture**
2	0.68	0.68	0.70	0.49	0.50	0.54
5	0.69	0.69	0.73	0.51	0.54	0.56
10	0.73	0.73	0.79	0.56	0.62	0.61
25	0.75	0.75	0.81	0.59	0.66	0.64
50	0.77	0.77	0.83	0.62	0.70	0.67
100	0.80	0.80	0.86	0.66	0.76	0.70

Return Period (Years)	**Runoff Coefficient** *	**Rainfall Intensity (in/hr)**	**Area (Acres)**	**Runoff (cfs)**	
2	0.53	2.72	10.88	15.74	
5	0.56	3.30	10.88	19.96	
10	0.61	3.83	10.88	25.50	**Q = CiA**
25	0.64	4.47	10.88	31.32	
50	0.68	5.03	10.88	37.00	
100	0.71	5.49	10.88	42.53	

Developed Conditions

21ST STREET KIDS AND FAMILY EMPOWERMENT

PLANNED UNIT DEVELOPMENT – PUD-20

GENERAL PROVISIONS

1. THIS DEVELOPMENT CONTAINS 32 ACRES.
2. PURPOSE – THE PLANNED UNIT DEVELOPMENT (PUD) ZONING DISTRICT PROVIDES INCREASED FLEXIBILITY OF THE ZONING STANDARDS WITHIN THE DEVELOPMENT. THE PROPOSED USES FOR THE PARCELS WITHIN THIS PUD ARE COMPATIBLE WITH THE ADJACENT RESIDENTIAL AREAS, BUT REQUIRE SOME FLEXIBILITY OF THE REQUIREMENTS UNDER THE CURRENT ZONING (B, MULTI-FAMILY) TO FACILITATE INTERACTION BETWEEN THE INSTITUTIONAL FACILITIES/COMMUNITY USES.
3. SETBACKS – AS NOTED ON THE PLAN.
4. UTILITIES – ALL UTILITIES SHALL BE INSTALLED UNDERGROUND.
5. DRAINAGE – A DRAINAGE PLAN AND GUARANTEES FOR THE DRAINAGE IMPROVEMENTS SHALL BE PROVIDED AT THE TIME OF PLATTING.
6. ACCESS CONTROL
   - A. 21ST STREET NORTH – COMPLETE ACCESS CONTROL EXCEPT JARDINE DRIVE, A PUBLIC STREET WITH A DIVIDED ENTRY OFF OF 21ST STREET NORTH.
   - B. 25TH STREET NORTH – COMPLETE ACCESS CONTROL EXCEPT TWO OPENINGS.
7. EXTERIOR LIGHTING
   - A. ALL LIGHTING SHALL BE SHIELDED TO REFLECT LIGHT DOWNWARD AND AWAY FROM RESIDENTIAL AREAS.
   - B. ALL PARKING LOT LIGHTING SHALL HAVE CONSISTENT DESIGN (I.E. FIXTURES, POLES, LAMPS, ETC.)
   - C. THE MAXIMUM HEIGHT FOR ALL PARKING LOT LIGHTING FIXTURES SHALL NOT EXCEED 14 FEET IF WITHIN 100 FEET OF RESIDENTIAL ZONING.
8. ARCHITECTURAL CONTROL
   - A. BUILDINGS ON PARCELS 1, 2, 3 AND 4 SHALL HAVE COMPATIBLE ARCHITECTURAL DESIGN AND EXTERIOR BUILDING MATERIALS (STONE, STUCCO, BRICK, WOOD).
   - B. BUILDINGS WITH METAL EXTERIORS WILL REQUIRE ARCHITECTURAL APPROVAL BY THE DIRECTOR OF PLANNING.
9. SCREENING
   - A. THE SCREENING REQUIREMENTS SHALL BE INSTALLED AS EACH PARCEL IS DEVELOPED. THE GENERAL SCREENING REQUIREMENTS SHALL BE AS PER THE WICHITA-SEDGWICK COUNTY ZONING CODE.
   - B. TRASH ENCLOSURES SHALL BE LOCATED NO CLOSER THAT 20 FEET FROM RESIDENTIAL ZONING.
   - C. ROOFTOP MECHANICAL EQUIPMENT SHALL BE SCREENED FROM THE GROUND LEVEL VIEW.
10. LANDSCAPE REQUIREMENTS
    - A. LANDSCAPE BUFFERS AND SCREENING SHALL BE IN ACCORDANCE WITH THE LANDSCAPE ORDINANCE OF THE CITY OF WICHITA. A LANDSCAPE PLAN INDICATING THE LOCATION, TYPE, AND SPECIFICATION OF PLANT MATERIALS SHALL BE SUBMITTED TO THE PLANNING DEPARTMENT FOR REVIEW AND APPROVAL PRIOR TO THE ISSUANCE OF A BUILDING PERMIT FOR THE SUBJECT PARCEL.
    - B. ONE SHADE TREE (OR TWO ORNAMENTAL TREES) ARE REQUIRED FOR EACH TWENTY SPACES. IN PARKING LOTS CONTAINING OVER 50 SPACES WITH TWO OR MORE AISLES AND THREE OR MORE BAYS IN ONE CONTIGUOUS AREA, ONE-HALF OF THE REQUIRED PARKING LOT TREES SHALL BE IN INTERIOR PLANTING ISLANDS WITH A MINIMUM OF 25 SQ.FT. OF PERMEABLE AREA.
11. SIGNAGE
    - A. MONUMENT SIGNS – RESERVE A AND RESERVE B SHALL EACH PERMIT ONE MONUMENT SIGN WITH A MAXIMUM HEIGHT OF 25 FEET AND A MAXIMUM SIGN AREA OF 250 SQ.FT.

      PARCELS 1, 2, 3 AND 4 SHALL EACH PERMIT ONE MONUMENT SIGN WITH A MAXIMUM HEIGHT OF 15 FEET AND A MAXIMUM SIGN AREA OF 150 SQ.FT.
    - B. BUILDING SIGNS – BUILDING SIGNAGE SHALL BE SUBJECT TO THE CODE REQUIREMENTS FOR SIGNAGE IN GENERAL OFFICE ZONING.
    - C. NO PORTABLE OR OFF-SITE SIGNS SHALL BE PERMITTED ON ANY PARCEL.
12. CIRCULATION
    - A. VEHICULAR CIRCULATION – AN OVERALL SITE TRAFFIC PLAN SHALL BE SUBMITTED TO THE DIRECTOR OF PLANNING PRIOR THE ISSUANCE OF BUILDING PERMITS.
    - B. PEDESTRIAN CIRCULATION – THE GENERAL SIDEWALK LAYOUT IS SHOWN ON THE PLAN. AS EACH PARCEL IS DEVELOPED, A PLAN THAT ILLUSTRATES THE PEDESTRIAN CIRCULATION SHALL BE SUBMITTED TO THE DIRECTOR OF PLANNING FOR APPROVAL PRIOR TO THE ISSUANCE OF THE BUILDING PERMIT FOR THE SUBJECT PARCEL.
13. FIRE LANES – SHALL BE IN ACCORDANCE WITH THE FIRE CODE OF THE CITY OF WICHITA. NO PARKING SHALL BE ALLOWED IN SAID FIRE LANES, ALTHOUGH THEY MAY BE USED FOR PASSENGER LOADING AND UNLOADING. DURING THE BUILDING PERMIT REVIEW, THE FIRE CHIEF, OR HIS DESIGNATED REPRESENTATIVE, SHALL APPROVE THE SITE PLAN REGARDING THE DESIGN OF THE FIRE LANES PRIOR TO THE ISSUANCE OF A BUILDING PERMIT FOR THE SUBJECT PARCEL.
14. PARKING – SEE PARCEL DESCRIPTIONS.
15. OWNERS ASSOCIATION – IF THERE IS MULTIPLE OWNERSHIP, AN OWNERS ASSOCIATION AGREEMENT FOR THE MAINTENANCE OF RESERVES, OPEN SPACE, INTERNAL DRIVES, PARKING AREAS, DRAINAGE IMPROVEMENTS, ETC., SHALL BE FILED WITH THE PLAT OF THIS AREA.
16. THE TRANSFER OF TITLE ON ALL OR ANY PORTION OF THE LAND INCLUDED IN THE DEVELOPMENT DOES NOT CONSTITUTE A TERMINATION OF THE PLAN OR ANY PORTION THEREOF, BUT SAID PLAN SHALL RUN WITH THE LAND FOR DEVELOPMENT AND BE BINDING UPON THE PRESENT LAND OWNERS, THEIR SUCCESSORS AND ASSIGNS AND THEIR LESSEES UNLESS AMENDED.
17. STREETS (PUBLIC) – IN ORDER TO MAINTAIN THE EXISTING CHARACTER OF THE DEVELOPMENT AND SAVE EXISTING TREES, THE USE OF ONE-WAY STREETS AND REDUCED PAVEMENT WIDTHS SHALL BE PERMITTED. THE MINIMUM WIDTH OF A ONE-WAY STREET SHALL BE 21 FEET FROM BACK OF CURB TO BACK OF CURB, A MINIMUM RIGHT OF WAY OF 60 FEET SHALL ALSO BE PERMITTED, AND PERPENDICULAR OR ANGLE PARKING MAY BE PERMITTED ALONG THE PUBLIC STREET FOR PARCELS 1, 2, AND 3.

PARCEL DESCRIPTIONS

PARCEL 1:

PROPOSED USES: TOP FACILITY (PRESCHOOL FACILITY)

GROSS AREA: 5.35 ACRES (233,068 SQ.FT.)
MAXIMUM BUILDING COVERAGE: 30%
MAXIMUM BUILDING FLOOR AREA: 69,920 SQ.FT.
MAXIMUM BUILDING HEIGHT: 35 FT
PARKING PROVIDED: PER ZONING CODE FOR GENERAL DAY CARE CENTER USE.
SETBACKS: (SEE PLAN)

PARCEL 2:

PROPOSED USES: GOVERNMENTAL SERVICES, RECREATIONAL USES, GENERAL DAY CARE, COMMUNITY ASSEMBLY.

GROSS AREA: 4.23 ACRES (184,378 SQ.FT.)
MAXIMUM BUILDING COVERAGE: 30%
MAXIMUM BUILDING FLOOR AREA: 55,313 SQ.FT.
MAXIMUM BUILDING HEIGHT: 35 FT
PARKING PROVIDED: PER ZONING CODE
SETBACKS: (SEE PLAN)

PARCEL 3:

PROPOSED USES: BOYS AND GIRLS CLUB, GOVERNMENTAL SERVICES, RECREATIONAL USES, GENERAL DAY CARE, COMMUNITY ASSEMBLY.

GROSS AREA: 5.58 ACRES (243,273 SQ.FT.)
MAXIMUM BUILDING COVERAGE: 30%
MAXIMUM BUILDING FLOOR AREA: 70,982 SQ.FT.
MAXIMUM BUILDING HEIGHT: 35 FT
PARKING PROVIDED: PER CODE EXCEPT FOR THE BOYS AND GIRLS CLUB WHICH SHALL PERMIT 3 SPACES PER 1,000 SQ.FT. OF FLOOR AREA.
SETBACKS: (SEE PLAN)

PARCEL 4:

PROPOSED USES: GOVERNMENTAL SERVICES, RECREATIONAL USES, ELEMENTARY SCHOOL, COMMUNITY ASSEMBLY.

GROSS AREA: 8.87 ACRES (386,197 SQ.FT.)
MAXIMUM BUILDING COVERAGE: 30%
MAXIMUM BUILDING FLOOR AREA: 115,859 SQ.FT.
MAXIMUM BUILDING HEIGHT: 35 FT
PARKING PROVIDED: PER CODE
SETBACKS: (SEE PLAN)

RESERVE A:

PROPOSED USES: MONUMENT SIGN, LANDSCAPING, IRRIGATION, SIDEWALKS

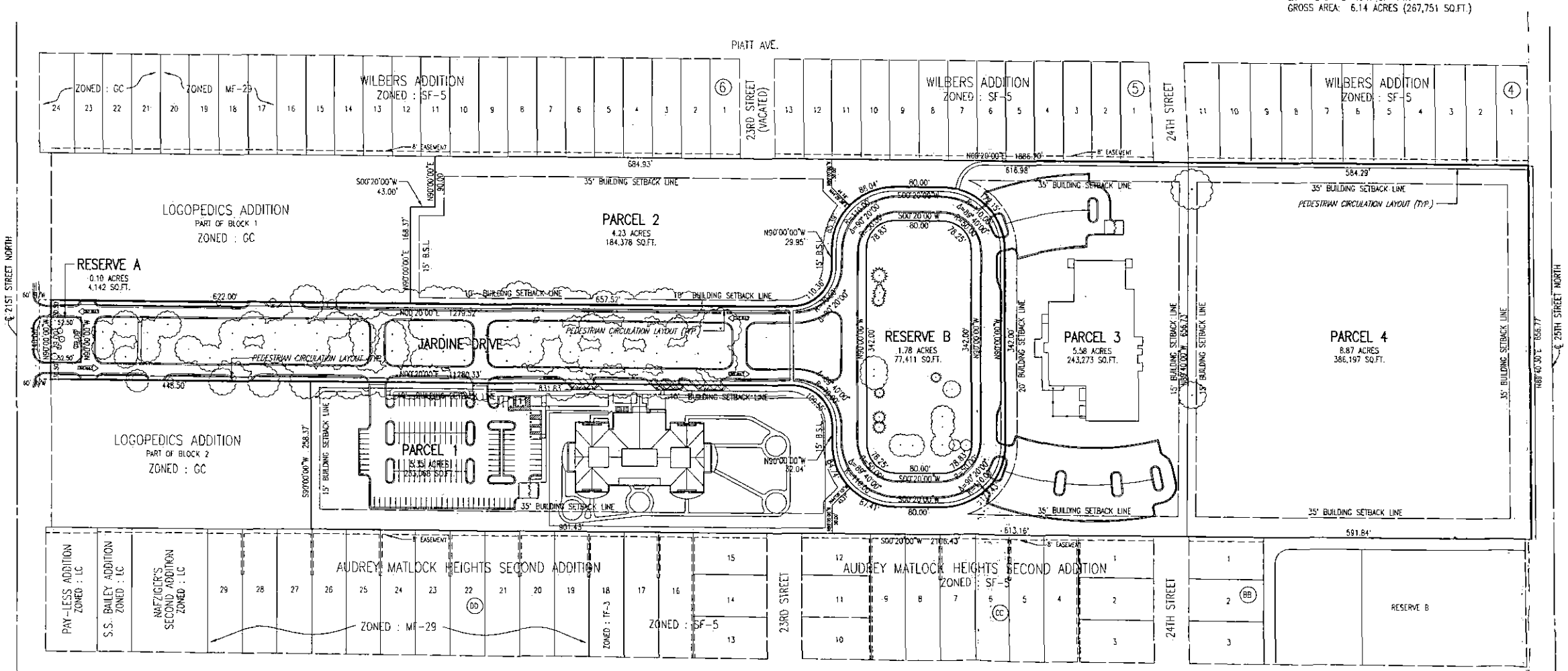
GROSS AREA: 0.10 ACRES (4,142 SQ.FT.)

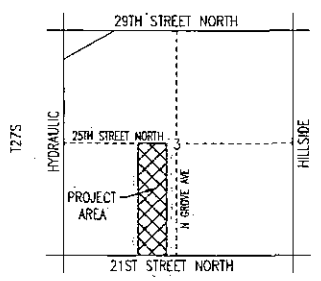
RESERVE B:

PROPOSED USES: MONUMENT SIGNS, PICNIC PAVILIONS, PLAYGROUND, SIDEWALKS, LANDSCAPING, IRRIGATION, OFF-STREET PARKING

GROSS AREA: 1.78 ACRES (77,411 SQ.FT.)

JARDINE DRIVE RIGHT OF WAY:
GROSS AREA: 6.14 ACRES (267,751 SQ.FT.)





VICINITY MAP

SCALE: 1" = 100'-0"
0 100 200

DATE	REVISION	DESCRIPTION
AUGUST 15, 2003		ORIGINAL

Professional Engineering Consultants, P.A
303 S. TOPEKA - WICHITA, KANSAS 67202 - 316 262-2691 - FAX 316-262-3063
www.pec1.com - designers@pec1.com

DSNR: RHH OPER: RLB
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Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project 21st St. Kids By BLB Date 9-16-05

Location Basin 1 Checked ____ Date ____

Circle one: Present (Developed)

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	UPPER			
1. Surface description (table 3-1)			grass			
2. Manning's roughness coeff., n (table 3-1) ..			0.030			
3. Flow length, L (total L ≤ 300 ft)	ft		300			
4. Two-yr 24-hr rainfall, P_2	in		3.50			
5. Land slope, s	ft/ft		0.020			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr		0.10	+		= 0.10
Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft					
9. Watercourse slope, s	ft/ft					
10. Average velocity, V (figure 3-1)	ft/s					
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr			+		=
Channel flow		Segment ID	LOWER			
12. Cross sectional flow area, a	ft^2		1.23			
13. Wetted perimeter, p_w	ft		3.93			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft		0.31			
15. Channel slope, s	ft/ft		0.0038			
16. Manning's roughness coeff., n			0.013			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s		3.24			
18. Flow length, L	ft		1,930			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.17	+		= 0.17
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					0.27

Water sheet flows from the furthest NE corner of Basin 1 to Proposed Street where it is carried via 15" RCP to 21st St. N.

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project 21st Kids By BLB Date 9-16-05

Location Basin 2 Checked _____ Date _____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	UPPER	LOWER	
1. Surface description (table 3-1)		Grass	Grass	
2. Manning's roughness coeff., n (table 3-1)		0.030	0.030	
3. Flow length, L (total L ≤ 300 ft)	ft	215	480	
4. Two-yr 24-hr rainfall, P_2	in	3.50	3.50	
5. Land slope, s	ft/ft	0.010	0.010	
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.10	+ 0.20	= 0.30

Shallow concentrated flow	Segment ID	MIDDLE		
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	265		
9. Watercourse slope, s	ft/ft	0.020		
10. Average velocity, V (figure 3-1)	ft/s	2.95		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.02	+	= 0.02

Channel flow	Segment ID			
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, P_w	ft			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft			
15. Channel slope, s	ft/ft			
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s			
18. Flow length, L	ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.32

water sheet flows from the furthest NE corner of Basin 2 to parking lot then sheet flows to 24th St N.

Project: **21st Street Kids and Family Empowerment**
Date: 9/16/2005
Prep. By: BLB

BASIN 1 - DEVELOPED CONDITIONS

Total Area 29.02 Acres

Soil Group	**A** (% of Total Area)	**B** (% of Total Area)	**C** (% of Total Area)	**D** (% of Total Area)	**Total**
	0%	100%	0%	0%	100%
Acres	0.00	29.02	0.00	0.00	29.02

Land Use	**Commercial** (% of Total Area)	**Industrial** (% of Total Area)	**Multi-Family** (% of Total Area)	**Public** (% of Total Area)	**Single Family** (% of Total Area)	**Vacant/Agriculture** (% of Total Area)
Developed	80%	0%	0%	0%	20%	0%
Acres	23.22	0.00	0.00	0.00	5.80	0.00

Runoff Coefficients * Used Soil Group D To Be Conservative

Return Period (Years)	**Commercial**	**Industrial**	**Multi-Family**	**Public**	**Single Family**	**Vacant/Agriculture**
2	0.68	0.68	0.70	0.49	0.50	0.54
5	0.69	0.69	0.73	0.51	0.54	0.56
10	0.73	0.73	0.79	0.56	0.62	0.61
25	0.75	0.75	0.81	0.59	0.66	0.64
50	0.77	0.77	0.83	0.62	0.70	0.67
100	0.80	0.80	0.86	0.66	0.76	0.70

Return Period (Years)	**Runoff Coefficient** *	**Rainfall Intensity (in/hr)**	**Area (Acres)**	**Runoff (cfs)**
2	0.64	3.72	29.02	69.52
5	0.66	4.43	29.02	84.85
10	0.71	5.08	29.02	104.37
25	0.73	5.90	29.02	125.33
50	0.76	6.60	29.02	144.80
100	0.79	7.18	29.02	165.02

Q = CiA

Project: **21st Street Kids and Family Empowerment**
Date: 9/16/2005
Prep. By: BLB

BASIN 2 - DEVELOPED CONDITIONS

Total Area 10.88 Acres

Soil Group	**A** (% of Total Area)	**B** (% of Total Area)	**C** (% of Total Area)	**D** (% of Total Area)	**Total**
	0%	100%	0%	0%	100%
Acres	0.00	10.88	0.00	0.00	10.88

Land Use	**Commercial** (% of Total Area)	**Industrial** (% of Total Area)	**Multi-Family** (% of Total Area)	**Public** (% of Total Area)	**Single Family** (% of Total Area)	**Vacant/Agriculture** (% of Total Area)
Developed	80%	0%	0%	0%	20%	0%
Acres	8.70	0.00	0.00	0.00	2.18	0.00

Runoff Coefficients * Used Soil Group D To Be Conservative

Return Period (Years)	**Commercial**	**Industrial**	**Multi-Family**	**Public**	**Single Family**	**Vacant/Agriculture**
2	0.68	0.68	0.70	0.49	0.50	0.54
5	0.69	0.69	0.73	0.51	0.54	0.56
10	0.73	0.73	0.79	0.56	0.62	0.61
25	0.75	0.75	0.81	0.59	0.66	0.64
50	0.77	0.77	0.83	0.62	0.70	0.67
100	0.80	0.80	0.86	0.66	0.76	0.70

Return Period (Years)	**Runoff Coefficient** *	**Rainfall Intensity (in/hr)**	**Area (Acres)**	**Runoff (cfs)**	
2	0.64	3.42	10.88	23.96	
5	0.66	4.10	10.88	29.44	
10	0.71	4.71	10.88	36.28	**Q = CiA**
25	0.73	5.47	10.88	43.56	
50	0.76	6.14	10.88	50.50	
100	0.79	6.68	10.88	57.56	

SUB-BASIN CALCULATIONS

Runoff Coefficients

C2	0.68
C100	0.80

Intensity

Tc	15 min
i2	3.5 in/hr
i100	7.8 in/hr

Basin	Node	Area	Q2	Q100
1A	N/A	0.38	0.90	2.37
1B	120	0.80	1.90	4.99
1C	132	1.29	3.07	8.05
1D	131	0.55	1.31	3.43
1E	133	0.45	1.07	2.81
1F	134	3.97	9.45	24.77
1G	142	2.36	5.62	14.73
1H	141	0.44	1.05	2.75
1I	143	0.39	0.93	2.43
1J	144	4.20	10.00	26.21
1K	152	1.42	3.38	8.86
1L	151	0.51	1.21	3.18
1M	153	0.50	1.19	3.12
1N	154	2.76	6.57	17.22
1O	163	1.11	2.64	6.93
1P	162	0.12	0.29	0.75
1Q	161	0.89	2.12	5.55
1R	164	0.10	0.24	0.62
1S	165	1.39	3.31	8.67
1T	170	0.89	2.12	5.55
1U	180	0.10	0.24	0.62
1V	190	1.34	3.19	8.36
1W	171	0.12	0.29	0.75
1X	172	2.96	7.04	18.47

INLET SIZING

Curb Inlets

Node	Q_2	Q_{max} (L=5')	Q_{max} (L=10')	Use L=
141	1.05	11	22	5
142	5.62	11	22	5
143	0.93	11	22	5
144	10.00	11	22	5
151	1.21	11	22	5
152	3.38	11	22	5
153	1.19	11	22	5
154	6.57	11	22	5
162	0.29	11	22	5
163	2.64	11	22	5
164	0.24	11	22	5
165	3.31	11	22	5
171	0.29	11	22	5
172	7.04	11	22	5
180	0.24	11	22	5
190	3.19	11	22	5

Area Inlets

Node	Q_2	Size	Perimeter	Depth
161	2.12	2' x 2'	8	0.20
170	2.12	2' x 2'	8	0.20

Depth = Q/(3*P)^2/3

Neenah R4826 2' x 2' Area Inlet

1.3 SF of open area

8 F Perimeter

STREET FLOW CHECKS

Basin	Node	Q2	Q100
1G	142	5.62	14.73
1H	141	1.05	2.75
1I	143	0.93	2.43
1J	144	10.00	26.21
1K	152	3.38	8.86
1L	151	1.21	3.18
1M	153	1.19	3.12
1N	154	6.57	17.22
1O	163	2.64	6.93
1P	162	0.29	0.75
1R	164	0.24	0.62
1S	165	3.31	8.67
1U	180	0.24	0.62
1V	190	3.19	8.36
1W	171	0.29	0.75
1X	172	7.04	18.47

2 Year

Node	Q2	Street Slope	d	dmax	Comment
144	10.00	0.20	0.55	0.30	NG

d = (Q/0.56*2000*S^0.5)^3/8

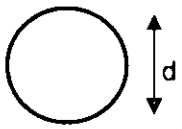
100 Year

Location	Q100	Qpipe	Qstreet	S	Qmax	Comment
Near nodes 143 & 144	28.64	0.00	28.64	0.20	10.79	NG

Qmax = 241.35*S^0.5

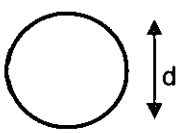
Pipe Sizing

k =	1.486	D =	12.00 in
n =	0.013	Q1 =	3.93 ft^3 / s
R =	0.250 ft		
S =	0.002 ft / ft		
V =	5.000 ft / s		
A =	0.785 ft^2		
P =	3.142 ft		



Pipe Sizing

k =	1.486	D =	15.00 in
n =	0.013	Q1 =	6.14 ft^3 / s
R =	0.313 ft		
S =	0.002 ft / ft		
V =	5.000 ft / s		
A =	1.227 ft^2		
P =	3.927 ft		



Grate Drop Inlet

Perimeter	8.00 ft	
Clear Opening Area	1.30 ft^2	
Orifice Area	0.78 ft^2	(Clear Opening x 0.60)
Static Pool Elevation	126.50 ft	

Weir Flow = 3.33*P*H^1.5
Orifice Flow = A*(2*32.16*H)^0.5

Elevation (ft)	Effective Head (ft)	Orifice Flow (cfs)	Weir Flow (cfs)	Total Flow (cfs)
126.50	0.00	0.00	0.00	0.0
126.75	0.25	3.13	3.33	3.1
127.00	0.50	4.42	9.42	4.4
127.25	0.75	5.42	17.30	5.4
127.50	1.00	6.26	26.64	6.3
127.75	1.25	6.99	37.23	7.0
128.00	1.50	7.66	48.94	7.7
128.25	1.75	8.28	61.67	8.3
128.50	2.00	8.85	75.35	8.8
128.75	2.25	9.38	89.91	9.4
129.00	2.50	9.89	105.30	9.9
129.25	2.75	10.37	121.49	10.4
129.50	3.00	10.83	138.43	10.8
129.75	3.25	11.28	156.08	11.3
130.00	3.50	11.70	174.44	11.7
130.25	3.75	12.11	193.46	12.1
130.50	4.00	12.51	213.12	12.5

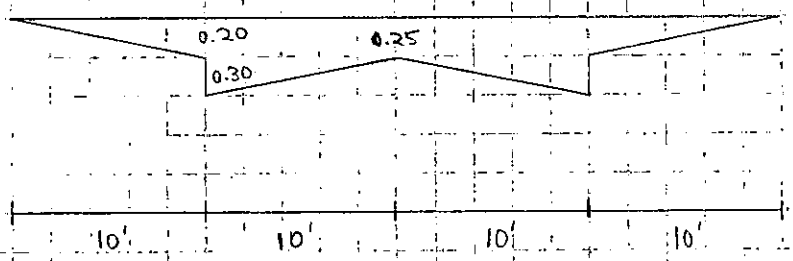
Professional Engineering Consultants, P.A.

03 S. TOPEKA • WICHITA, KANSAS 67202
316-262-2691 • FAX 316-262-3003
www.pec1.com • designers@pec1.com

Project _____ Date _____

Item Jardine Drive Capacity By _____

DETERMINE CAPACITIES OF ROLL CURB STREETS FOR 100-YR STORM ANALYSIS.



$\frac{(2 \times 9.5 \times 0.030) + (2 \times 3.05 \times 0.013) + (2 \times 8 \times 0.016)}{41.1} = 0.02203 = n$

$41.1 = P$

$(2 \times \frac{1}{2} \times 0.20 \times 10) + (0.50 \times 20) - (2 \times \frac{1}{2} \times 10 \times 0.25) = 9.5 \text{ SF} = A$

$\frac{9.5}{41.1} = 0.231 = R$

$0.231^{\frac{2}{3}} = 0.377 = R^{\frac{2}{3}}$

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

$\left(\frac{1.486}{0.02203}\right)(9.5)(0.377)\, S^{\frac{1}{2}} = 241.35\, S^{\frac{1}{2}} = Q$

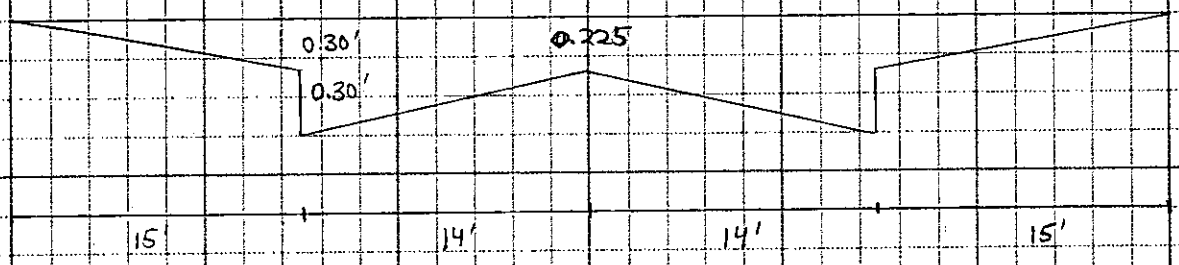
Professional Engineering Consultants, P.A.

S. TOPEKA ▪ WICHITA, KANSAS 67202
316-262-2691 ▪ FAX 316-262-3003
www.pec1.com ▪ designers@pec1.com

Project _____ Date _____

Item 24th Street North Capacity By _____

DETERMINE CAPACITIES OF ROLL CURB STREETS W/0.3' WALK GRADE FOR 100-YR STORM ANALYSIS (58' ROW, 29' BK-BK)



$$\frac{(2\times14.5\times0.030) + (2\times3.05\times0.013) + (2\times12\times0.016)}{59.1} = 0.02256 = n$$

$59.1 = P$

$(2\times\tfrac{1}{2}\times15\times0.30) + (28\times0.60) - (2\times\tfrac{1}{2}\times14\times0.375) = 16.1\ SF = A$

$16.1/59.1 = 0.272 = R$

$(0.272)^{2/3} = 0.420 = R^{2/3}$

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

$\left(\frac{1.486}{0.02256}\right)(16.1)(0.420)(S^{1/2}) = 445.65(S^{1/2}) = Q$

Existing Slope = 0.92%

$Q_{100} = 445.65(0.0092)^{1/2} = 42.75$ cfs

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN   1998                *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   18SEP05  TIME  11:40:33   *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

            1          ID      21st KIDS & FAMILY EMPOWERMENT
            2          ID      DEVELOPED CONDITIONS
            3          ID      BY BLB    DATE 09-18-05
*** LIST ***
*** FREE ***
                       *DIAGRAM
            4          IT      15 01JAN04    1200       0 02JAN04    2000
            5          IN      15 01JAN04    1200
            6          IO       0        5
            7          JR    PREC     3.5     4.5     5.3     6.1     7.0     7.8
                       *
                       *
                       *

            8          KK   10-1X
            9          KO       5
           10          BA   0.014
           11          PB    1.00
           12          PC   0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
           13          PC   0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
           14          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
           15          PC   0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
```

```
16          PC   0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
17          PC   0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
18          PC   0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
19          PC   0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
20          PC   0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
21          PC   0.982   0.985   0.988   0.991   0.994   0.997   1.000
22          LS       0      80      85
23          UD   0.150
            *
            *

24          KK    RESB
            *  1.78 AC DETENTION AREA WITH 2 AREA INLETS
25          KO       5
26          RS       1    ELEV   126.5
27          SA    0.00    0.83    1.27    1.78
28          SE   126.5   127.0   128.0   129.0
29          SQ       0     6.0     6.0
30          SE   126.5  126.75  129.00
            *
            *

31          KK   1A-1N
32          KO       5
33          BA   0.031
34          PB    1.00
35          PC   0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
36          PC   0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
37          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
38          PC   0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
39          PC   0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
40          PC   0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
41          PC   0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
1                                          HEC-1 INPUT                                    PAGE  2

LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

42          PC   0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
43          PC   0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
44          PC   0.982   0.985   0.988   0.991   0.994   0.997   1.000
45          LS       0      80      85
46          UD   0.150
            *
            *

47          KK    BSN1
            *  FLOW TO 21ST STREET NORTH
48          KO       5
49          HC       2       0
            *
            *

50          KK    BSN2
51          KO       5
52          BA   0.017
53          PB    1.00
54          PC   0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
55          PC   0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
56          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
57          PC   0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
```

```
          58          PC   0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
          59          PC   0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
          60          PC   0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
          61          PC   0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
          62          PC   0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
          63          PC   0.982   0.985   0.988   0.991   0.994   0.997   1.000
          64          LS       0      80      85
          65          UD   0.220
                      *
                      *

          66          KK   POND2
                      *  0.33 AC DRY DETENTION POND WITH 2 - 18 RCP
                      *  FLOW TO 24TH STREET NORTH
          67          KO       5
          68          RS       1    ELEV   100.0
          69          SA    0.33    0.40    0.50    0.60    0.70
          70          SE   100.0   101.0   102.0   103.0   104.0
          71          SQ       0     5.6    11.2    16.8    22.4    28.0    29.0    39.2    44.8    50.4
          72          SQ    56.0
          73          SE   100.0  100.88  101.32  101.74  102.29  103.01  103.16  104.94  106.13  107.54
          74          SE   109.4
                      *
                      *
                      *
                      *
          75          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
PUT
LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

 NO.      (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW

  8        10-1X
              V
              V
 24         RESB
              .
              .
 31           .       1A-1N
              .          -
              .          -
 47         BSN1.............
              .
              .
 50           .        BSN2
              .          V
              .          V
 66           .       POND2

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                  *****************************************
*                                       *                  *                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                  *    U.S. ARMY CORPS OF ENGINEERS       *
*             JUN   1998                *                  *    HYDROLOGIC ENGINEERING CENTER      *
*          VERSION 4.1                  *                  *         609 SECOND STREET             *
*                                       *                  *       DAVIS, CALIFORNIA 95616         *
*  RUN DATE   18SEP05  TIME  11:40:33   *                  *           (916) 756-1104              *
*                                       *                  *                                       *
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*****************************************                                                    ***************************************




                              21st KIDS & FAMILY EMPOWERMENT
                              DEVELOPED CONDITIONS
                              BY BLB    DATE 09-18-05

   6 IO          OUTPUT CONTROL VARIABLES
                       IPRNT          0  PRINT CONTROL
                       IPLOT          5  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN         15  MINUTES IN COMPUTATION INTERVAL
                       IDATE     1JAN 4  STARTING DATE
                       ITIME       1200  STARTING TIME
                          NQ        129  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     2JAN 4  ENDING DATE
                      NDTIME       2000  ENDING TIME
                       ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL     .25 HOURS
                      TOTAL TIME BASE   32.00 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN          1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    3.50     4.50     5.30     6.10     7.00     7.80


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   8 KK     *    10-1X   *
            *            *
            **************

   9 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          5  PRINT CONTROL
                       IPLOT          5  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
```

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 24 KK    *      RESB  *
          *            *
          **************

 25 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          5  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 31 KK    *     1A-1N  *
          *            *
          **************

 32 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          5  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 47 KK    *      BSN1  *
          *            *
          **************

 48 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          5  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 50 KK    *      BSN2  *
          *            *
          **************

 51 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
```

```
                    IPLOT          5  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  66 KK   *     POND2  *
          *            *
          **************

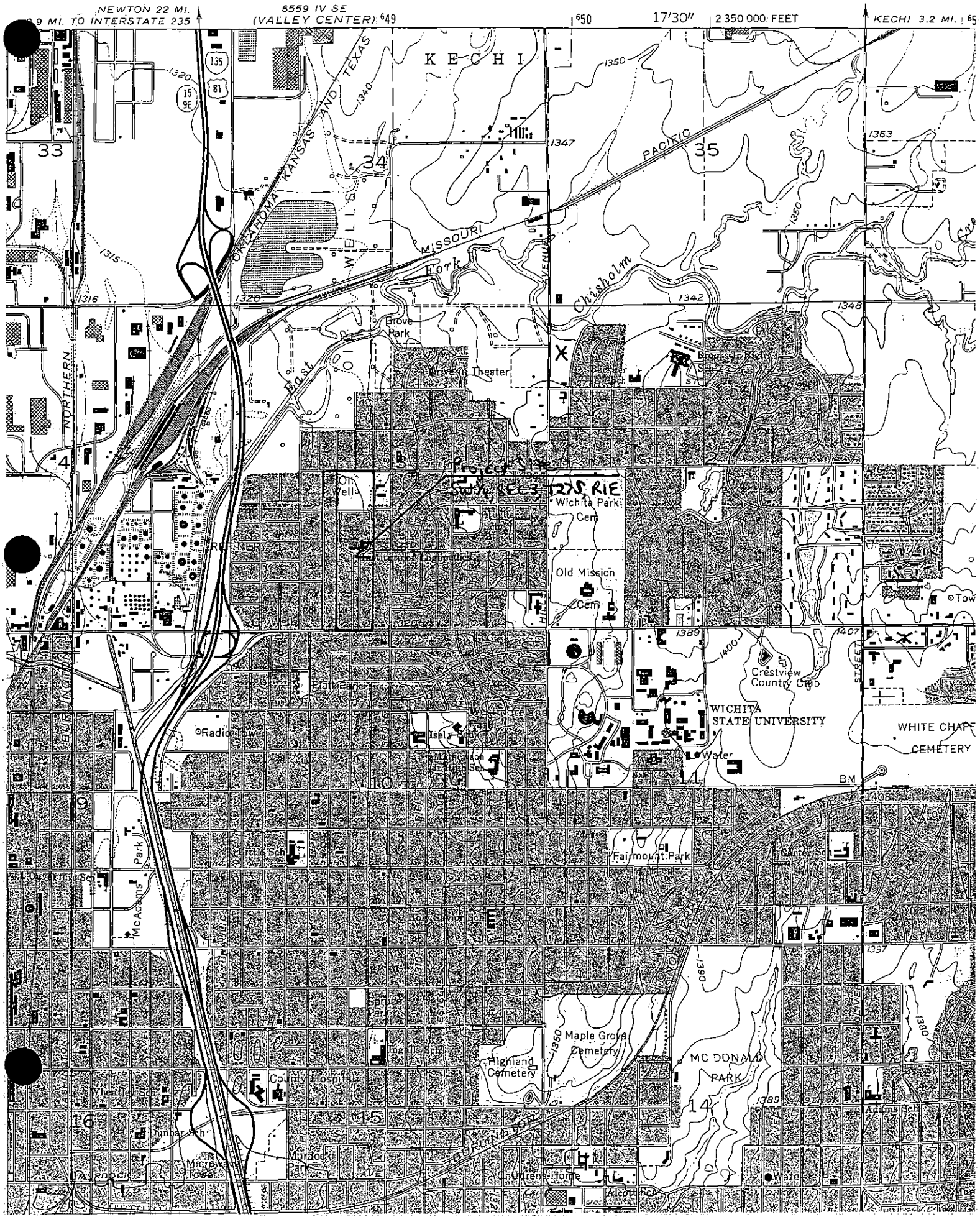
  67 KO         OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          5  PLOT CONTROL
                    QSCAL     .    0.  HYDROGRAPH PLOT SCALE
1
```

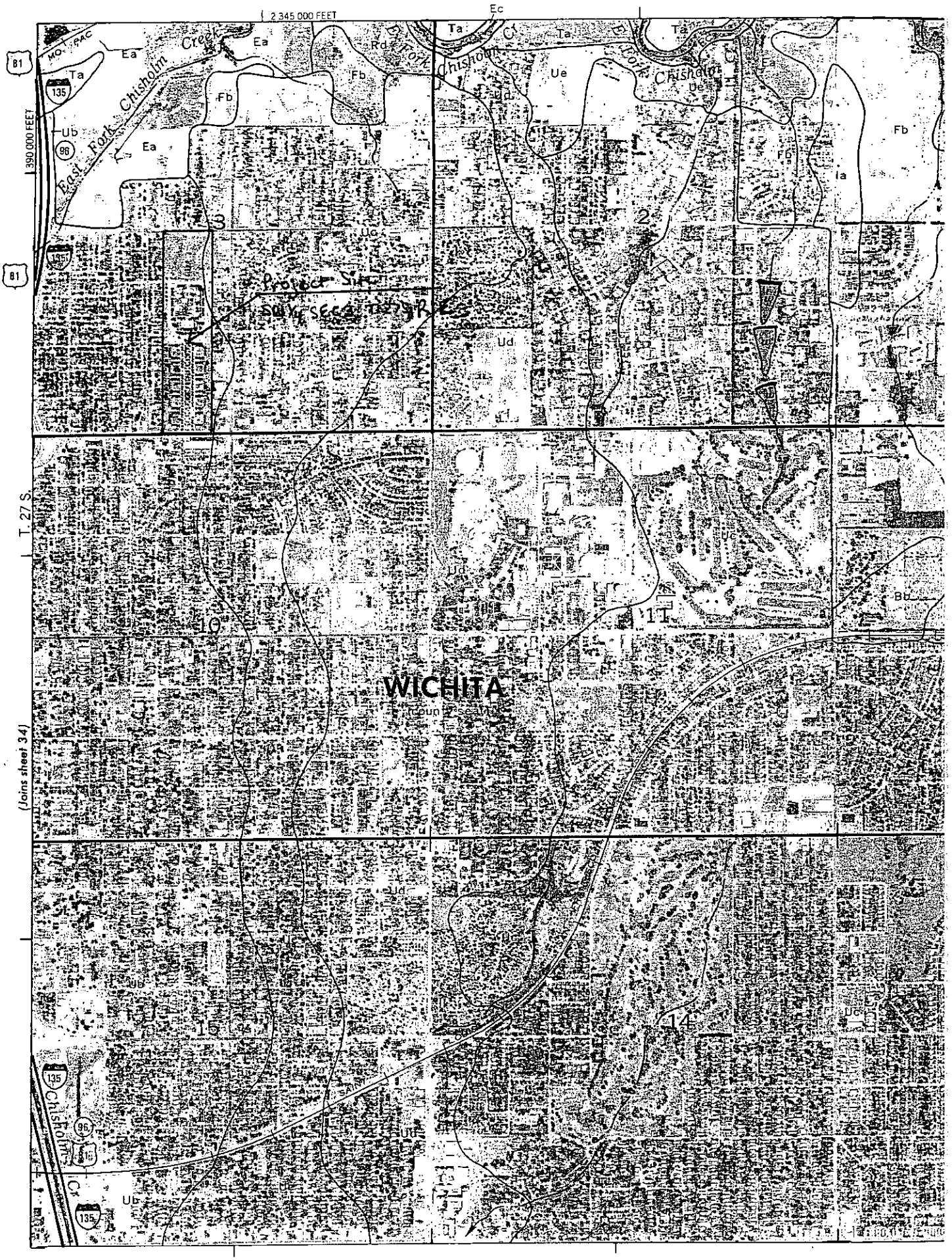
PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

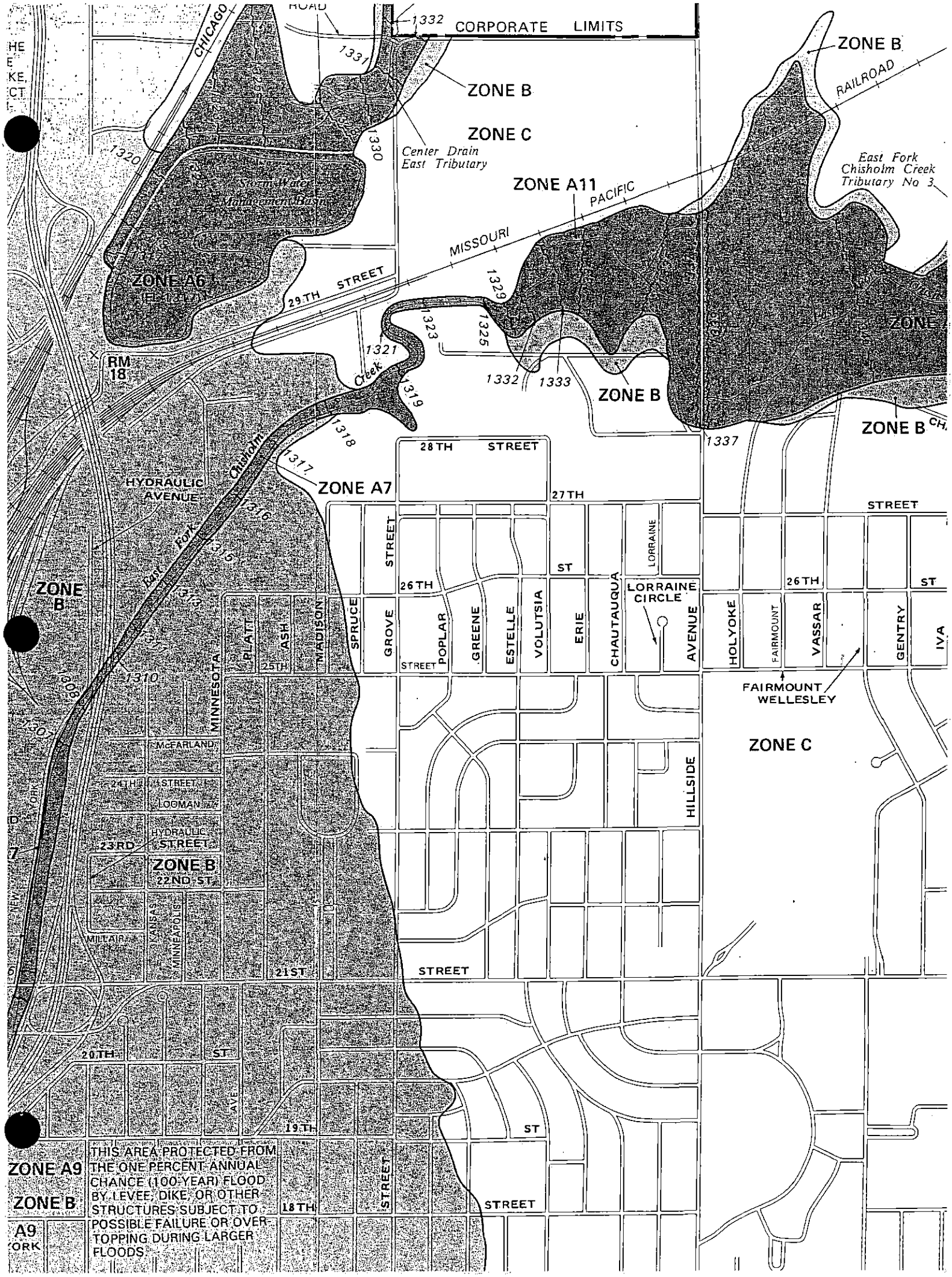
					RATIOS APPLIED TO PRECIPITATION					
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
					3.50	4.50	5.30	6.10	7.00	7.80
HYDROGRAPH AT										
+	10-1X	.01	1	FLOW	25.	33.	39.	45.	52.	58.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00
ROUTED TO										
+	RESB	.01	1	FLOW	6.	6.	6.	6.	6.	6.
				TIME	11.75	11.75	11.75	11.75	11.75	11.50
			** PEAK STAGES IN FEET **							
			1	STAGE	127.43	127.73	128.00	128.18	128.38	128.58
				TIME	12.50	12.75	12.75	12.75	13.00	13.00
HYDROGRAPH AT										
+	1A-1N	.03	1	FLOW	56.	73.	86.	100.	115.	129.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00
2 COMBINED AT										
+	BSN1	.05	1	FLOW	62.	79.	92.	106.	121.	135.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00
HYDROGRAPH AT										
+	BSN2	.02	1	FLOW	24.	31.	37.	43.	50.	56.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00
ROUTED TO										
	POND2	.02	1	FLOW	15.	19.	22.	24.	27.	29.
				TIME	12.25	12.50	12.50	12.50	12.50	12.50
			** PEAK STAGES IN FEET **							
			1	STAGE	101.57	101.94	102.25	102.56	102.93	103.24
				TIME	12.25	12.50	12.50	12.50	12.50	12.50

Design Aids

STATE OF KANSAS




2 345 000 FEET
390 000 FEET
T. 27 S.
(Joins sheet 34)
East Fork Chisholm Creek
Project Site
WICHITA
Ea
Fb
Ta
Ub
Ud
Ue
Ec
Rd
Bb
Ia
Uc
81
135
96
10
11
14
15


CORPORATE LIMITS
1332
1331
1330
1320
ZONE B
ZONE C
Center Drain
East Tributary
ZONE A11
PACIFIC
RAILROAD
East Fork
Chisholm Creek
Tributary No 3
MISSOURI
29TH STREET
ZONE A6
1329
1323
1325
1321
1332
1333
ZONE B
RM
18
Creek
1319
1318
1317
1337
28TH STREET
27TH
ZONE A7
HYDRAULIC
AVENUE
Chisholm
East Fork
1316
1315
1314
1313
1312
1311
1310
1308
26TH
25TH
24TH
23RD
22ND ST
21ST
20TH
19TH
18TH
STREET
ST
AVE
SPRUCE
GROVE
POPLAR
GREENE
ESTELLE
VOLUTSIA
ERIE
CHAUTAUQUA
LORRAINE
LORRAINE CIRCLE
AVENUE
HOLYOKE
FAIRMOUNT
VASSAR
GENTRY
IVA
WELLESLEY
FAIRMOUNT
HILLSIDE
MINNESOTA
PLATT
ASH
MADISON
McFARLAND
LOOMAN
HYDRAULIC
MILLAIR
KANSAS
MINNEAPOLIS
ZONE C
ZONE B
ZONE A9
ZONE B
A9
THIS AREA PROTECTED FROM THE ONE PERCENT ANNUAL CHANCE (100-YEAR) FLOOD BY LEVEE, DIKE, OR OTHER STRUCTURES SUBJECT TO POSSIBLE FAILURE OR OVER-TOPPING DURING LARGER FLOODS

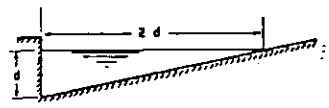
County	Expected 24-hour Storm Rainfall in Inches						Normal Annual Precipitation
	Storm Frequency in Years						
	100	50	25	10	5	2	Inches
Pawnee	6.6	6.0	5.2	4.5	3.7	2.8	23.3
Phillips	6.0	5.5	4.8	4.1	3.4	2.5	23.6
Pottawatomie	7.5	6.6	5.9	5.1	4.3	3.4	33.6
Pratt	7.2	6.4	5.6	4.8	4.1	3.0	24.6
Rawlins	5.5	5.0	4.3	3.6	3.1	2.3	21.0
Reno	7.4	6.6	5.8	5.0	4.2	3.2	27.7
Republic	6.8	6.0	5.4	4.6	3.9	2.9	28.6
Rice	7.3	6.4	5.6	4.8	4.1	3.0	26.6
Riley	7.4	6.5	5.8	5.1	4.3	3.3	33.5
Rooks	6.1	5.7	4.9	4.1	3.4	2.5	23.9
Rush	6.5	5.9	5.0	4.3	3.6	2.7	23.3
Russell	6.7	5.9	5.2	4.4	3.7	2.8	26.8
Saline	7.3	6.4	5.7	4.9	4.1	3.1	28.4
Scott	5.7	5.3	4.5	3.8	3.2	2.4	20.2
Sedgwick	7.8	7.0	6.1	5.3	4.5	3.5	30.6
Seward	6.0	5.7	4.8	4.2	3.5	2.6	19.8
Shawnee	7.8	6.8	6.1	5.3	4.5	3.5	34.7
Sheridan	5.7	5.3	4.5	3.8	3.2	2.4	21.3
Sherman	5.3	4.8	4.2	3.5	3.0	2.2	16.7
Smith	6.3	5.7	5.0	4.2	3.5	2.6	24.4
Stafford	7.1	6.2	5.5	4.7	4.0	2.9	25.1
Stanton	5.6	5.2	4.5	3.8	3.2	2.4	15.8
Stevens	5.9	5.5	4.7	4.1	3.4	2.5	19.7
Sumner	8.0	7.1	6.2	5.4	4.6	3.6	34.0

x-slope = 3/8"/ft = 0.03125

z = 1/x-slope = 1/0.03125 = 32

n = 0.016

z/n = 32/0.016 = 2000 always



EQUATION: $Q = 0.56\left(\frac{z}{n}\right) S^{\frac{1}{2}} d^{\frac{8}{3}}$

n IS ROUGHNESS COEFFICIENT IN MANNING FORMULA APPROPRIATE TO MATERIAL IN BOTTOM OF CHANNEL

z IS RECIPROCAL OF CROSS SLOPE

REFERENCE: H. R. B. PROCEEDINGS 1948, PAGE 150, EQUATION (14)

EXAMPLE (SEE INSTRUCTION 1)

GIVEN: S = 0.03

z = 24, n = .02 } z/n = 1200

Q = 2.0 CFS

FIND: d = 0.22 BY FOLLOWING DASHED LINES

RATIO z/n: 10000, 9000, 8000, 7000, 6000, 5000, 4000, 3000, 2000, 1000, 900, 800, 700, 600, 500, 400, 300, 200, 100, 90, 80, 70, 60, 50, 40, 30, 20, 10

TURNING LINE

DISCHARGE (Q) IN CFS: 100, 70, 50, 30, 20, 10, 7, 5, 3, 2, 1, .7, .5, .3, .2, .1, .07, .05, .03, .02, .01

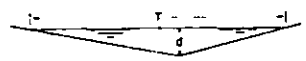
SLOPE OF CHANNEL (S) IN FT./FT.: .10, .08, .07, .06, .05, .04, .03, .02, .01, .008, .007, .006, .005, .004, .003, .002, .001

DEPTH AT CURB OR DEEPEST POINT (d) IN FT.: 2.0, 1.0, .90, .70, .60, .50, .40, .30, .20, .10, .08, .07, .06, .05, .04, .03, .02, .01

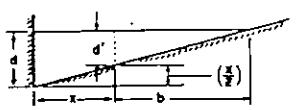
INSTRUCTIONS

1. CONNECT z/n RATIO WITH SLOPE (S) AND CONNECT DISCHARGE (Q) WITH POINT WHERE LINE CROSSES TURNING LINE READ DEPTH AT CURB (d) Q CAN BE FOUND FROM d BY CONNECTING d WITH CROSSING OF TURNING LINE

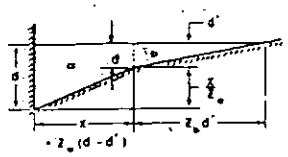
2. FOR SHALLOW V-SHAPED CHANNEL AS SHOWN USE NOMOGRAPH AS EXPLAINED IN INSTRUCTION 1 BUT WITH $z = \frac{T}{d}$



3. TO DETERMINE DISCHARGE Q_x IN PORTION OF CHANNEL HAVING WIDTH X: DETERMINE DEPTH d FOR TOTAL DISCHARGE IN ENTIRE SECTION AS EXPLAINED IN 1. THEN USE NOMOGRAPH TO DETERMINE Q_b IN SECTION OF WIDTH b FOR DEPTH $d' = d - \left(\frac{x}{z}\right)$. THEN $Q_x = Q - Q_b$.



4. TO DETERMINE DISCHARGE (Q_T) IN COMPOSITE SECTION:- FOLLOW INSTRUCTION 3 TO OBTAIN DISCHARGE (Q_a) IN SECTION a AT ASSUMED DEPTH d BASED ON AN EXTENSION OF SLOPE RATIO z_a TO INTERSECT WATER SURFACE; OBTAIN Q_b FOR SLOPE RATIO z_b AND DEPTH d'; $d' = d - \frac{x}{z_a}$ THEN $Q_T = Q_a + Q_b$.



BUREAU OF PUBLIC ROADS

REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

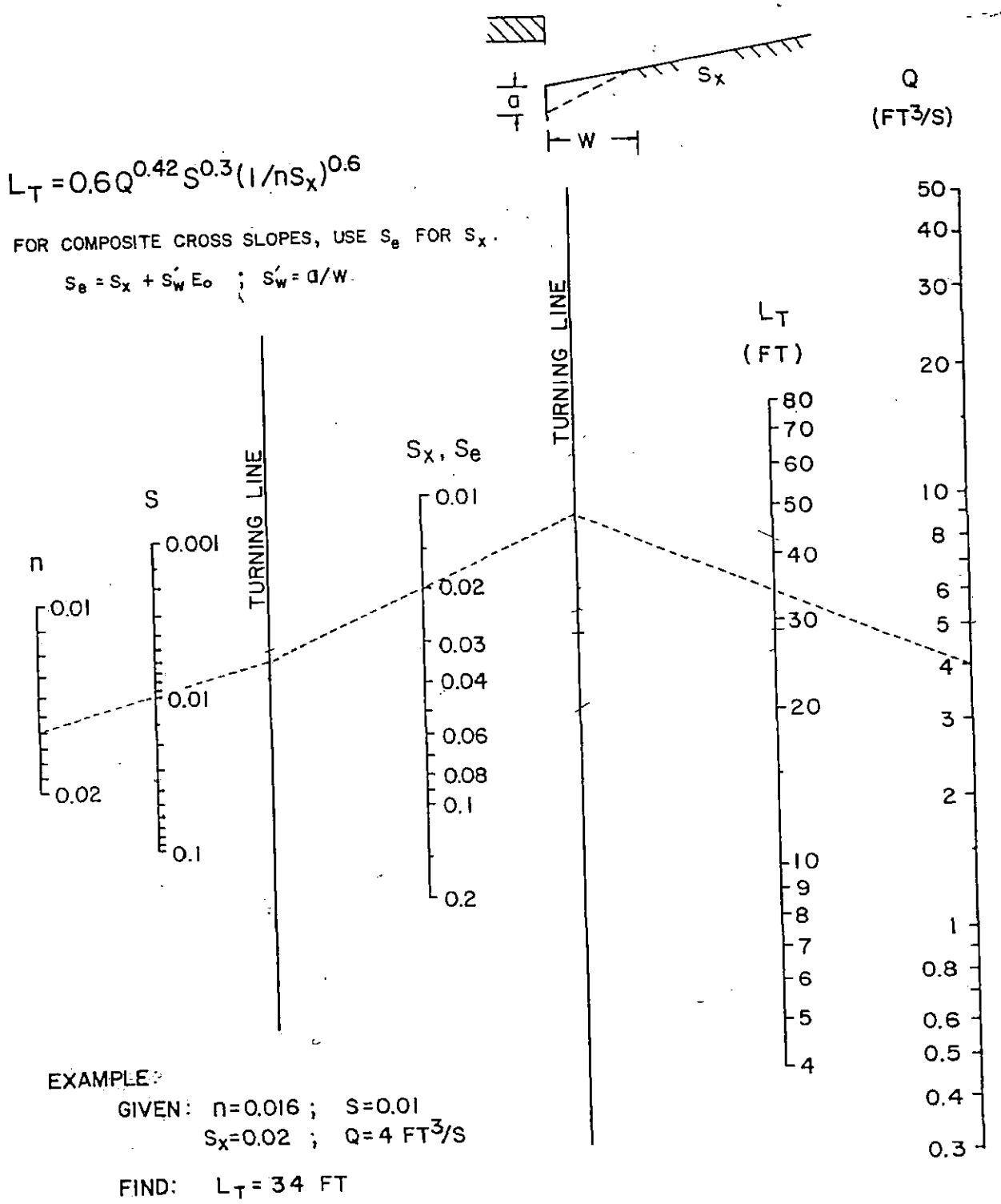


CHART 9. Curb-opening and slotted drain inlet length for total interception.

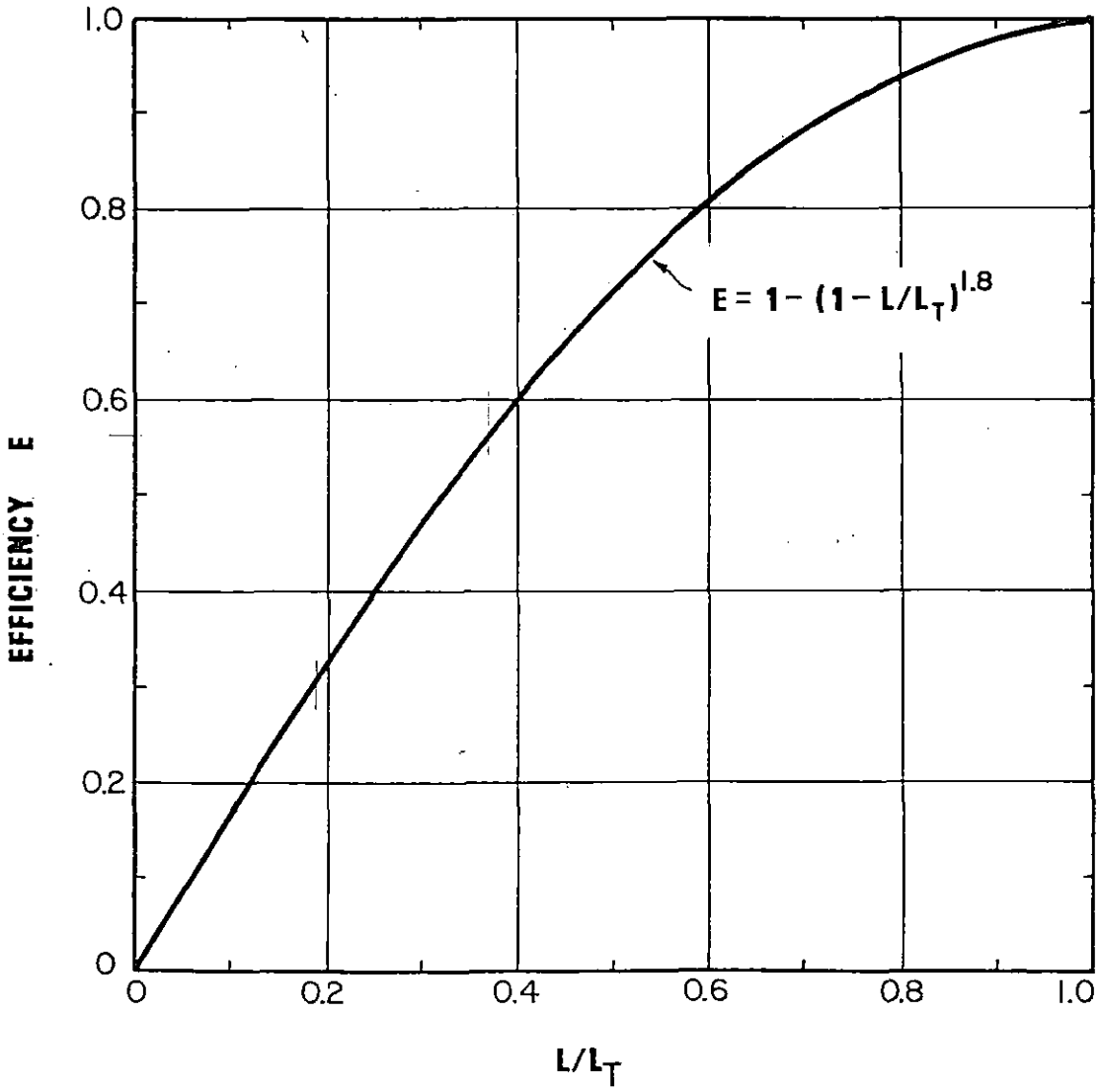


CHART 10. Curb-opening and slotted drain inlet interception efficiency.

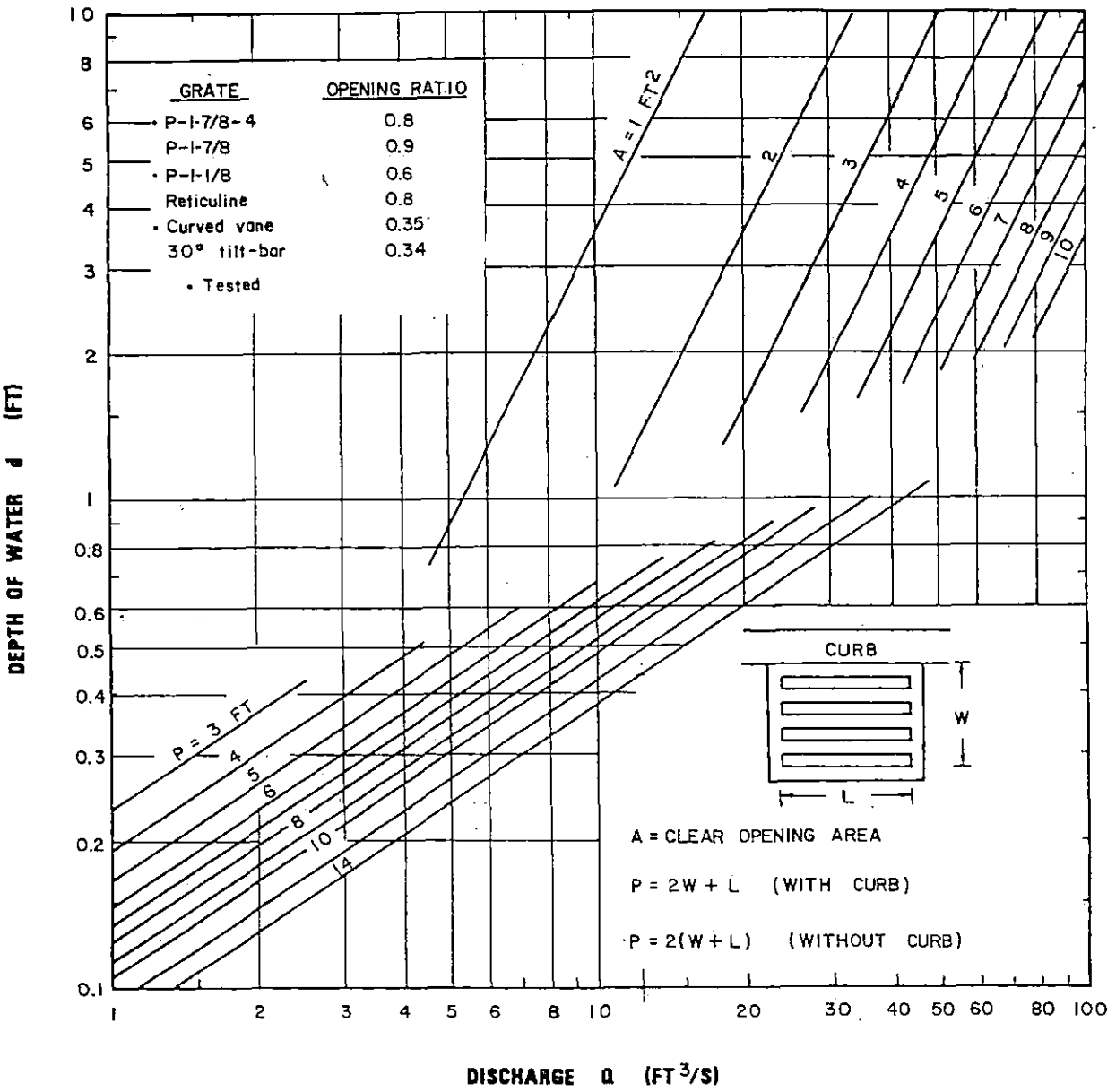


CHART 11. Grate inlet capacity in sump conditions.

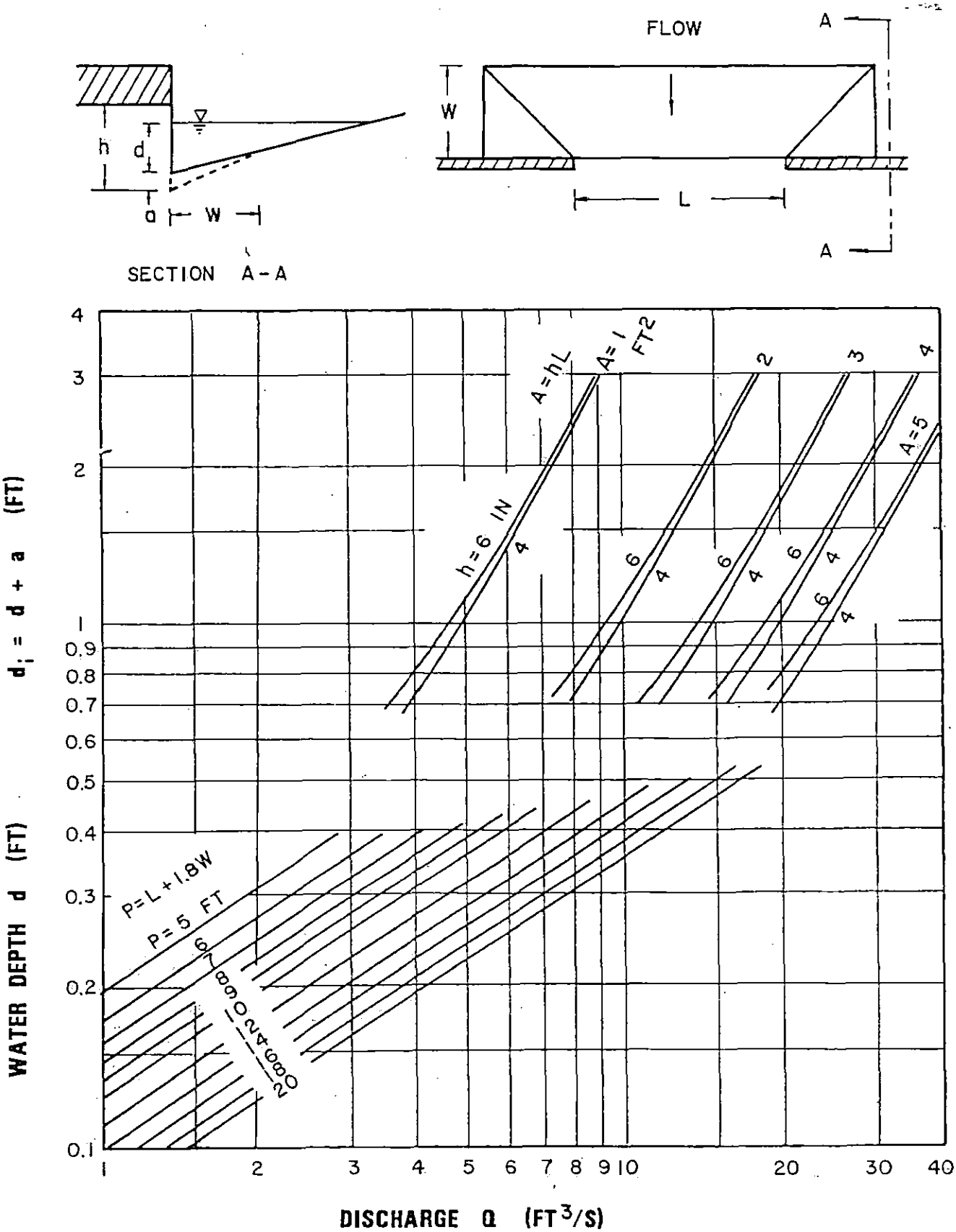


CHART 12. Depressed curb-opening inlet capacity in sump locations.

April 15, 1986

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40 Modified to NWS Hydro-35, 1977 During First Hour

(t_c)

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	i = 4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
11	3.27	4.36	5.16	5.89	6.81	7.61	8.27
12	3.18	4.21	4.99	5.71	6.60	7.38	8.02
13	3.05	4.08	4.84	5.53	6.41	7.17	7.79
14	2.96	3.95	4.69	5.37	6.23	6.97	7.57
15	2.87	3.83	4.56	5.22	6.06	6.78	7.37
16	2.78	3.72	4.43	5.08	5.90	6.60	7.18
17	2.71	3.61	4.31	4.95	5.75	6.44	7.00
18	2.63	3.51	4.20	4.83	5.61	6.29	6.84
19	2.56	3.42	4.10	4.71	5.47	6.14	6.68
20	2.50	3.33	4.00	4.60	5.35	6.00	6.53
21	2.44	3.25	3.90	4.50	5.23	5.87	6.39
22	2.38	3.17	3.81	4.40	5.12	5.75	6.26
23	2.32	3.10	3.73	4.31	5.01	5.63	6.13
24	2.27	3.03	3.65	4.22	4.91	5.52	6.01
25	2.22	2.96	3.57	4.13	4.81	5.41	5.90
26	2.20	2.90	3.50	4.05	4.72	5.31	5.79
27	2.16	2.84	3.43	3.98	4.63	5.21	5.69
28	2.14	2.78	3.37	3.90	4.55	5.12	5.59
29	2.11	2.72	3.30	3.83	4.47	5.03	5.49
30	2.08	2.67	3.24	3.76	4.39	4.94	5.40
31	2.05	2.62	3.19	3.70	4.32	4.86	5.32
32	2.02	2.57	3.10	3.63	4.25	4.79	5.22
33	1.99	2.52	3.05	3.57	4.18	4.71	5.14
34	1.96	2.48	3.01	3.51	4.11	4.63	5.07
35	1.93	2.44	2.98	3.46	4.05	4.56	5.00
36	1.91	2.39	2.93	3.41	3.99	4.50	4.93
37	1.89	2.35	2.88	3.36	3.93	4.43	4.86
38	1.87	2.32	2.84	3.31	3.87	4.37	4.79
39	1.85	2.28	2.80	3.26	3.82	4.31	4.73
40	1.83	2.24	2.76	3.22	3.76	4.25	4.66
41	1.81	2.21	2.72	3.17	3.71	4.19	4.60
42	1.79	2.18	2.68	3.13	3.66	4.13	4.54
43	1.77	2.14	2.64	3.09	3.61	4.08	4.49
44	1.75	2.11	2.61	3.05	3.57	4.03	4.43
45	1.73	2.08	2.57	3.01	3.52	3.98	4.38

ATTACHMENT A CONTINUED
Page 2

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	.5-YR	10-YR	25-YR	50-YR	100-YR
46	1.70	2.05	2.54	2.97	3.48	3.93	4.33
47	1.67	2.02	2.50	2.93	3.44	3.88	4.28
48	1.66	2.00	2.47	2.90	3.39	3.84	4.23
49	1.64	1.97	2.44	2.86	3.35	3.79	4.18
50	1.61	1.95	2.41	2.83	3.32	3.75	4.13
51	1.59	1.92	2.38	2.79	3.28	3.71	4.09
52	1.56	1.89	2.35	2.76	3.24	3.67	4.05
53	1.54	1.86	2.33	2.73	3.20	3.63	4.00
54	1.52	1.84	2.30	2.70	3.17	3.59	3.96
55	1.50	1.81	2.27	2.67	3.14	3.55	3.92
56	1.47	1.79	2.25	2.64	3.10	3.51	3.88
57	1.45	1.76	2.22	2.61	3.07	3.48	3.84
58	1.43	1.74	2.20	2.59	3.04	3.44	3.81
59	1.42	1.72	2.18	2.56	3.01	3.41	3.77
60	1.40	1.69	2.15	2.53	2.98	3.37	3.73
61	1.38	1.67	2.13	2.51	2.95	3.34	3.70
62	1.36	1.65	2.11	2.48	2.92	3.31	3.67
63	1.34	1.63	2.09	2.46	2.89	3.28	3.63
64	1.33	1.61	2.07	2.44	2.86	3.25	3.60
65	1.31	1.59	2.05	2.41	2.84	3.22	3.57
66	1.30	1.57	2.03	2.39	2.81	3.19	3.54
67	1.28	1.56	2.01	2.37	2.79	3.16	3.51
68	1.26	1.54	1.99	2.35	2.76	3.13	3.48
69	1.25	1.52	1.97	2.33	2.74	3.10	3.45
70	1.24	1.50	1.95	2.31	2.71	3.08	3.42
71	1.22	1.49	1.93	2.28	2.69	3.05	3.39
72	1.21	1.47	1.92	2.26	2.67	3.02	3.36
73	1.20	1.46	1.90	2.25	2.64	3.00	3.34
74	1.18	1.44	1.88	2.23	2.63	2.98	3.31
75	1.17	1.43	1.86	2.21	2.61	2.95	3.29
76	1.16	1.41	1.85	2.19	2.58	2.93	3.26
77	1.15	1.40	1.83	2.17	2.55	2.90	3.24
78	1.13	1.38	1.82	2.15	2.53	2.88	3.22
79	1.12	1.37	1.80	2.14	2.50	2.86	3.19
80	1.11	1.36	1.79	2.12	2.48	2.84	3.16
81	1.10	1.34	1.77	2.10	2.46	2.82	3.13
82	1.09	1.33	1.76	2.08	2.43	2.79	3.10
83	1.08	1.32	1.74	2.06	2.41	2.76	3.07
84	1.07	1.31	1.73	2.04	2.39	2.74	3.04
85	1.06	1.30	1.72	2.02	2.37	2.71	3.01
86	1.05	1.28	1.70	2.00	2.34	2.69	2.99
87	1.04	1.27	1.69	1.99	2.32	2.66	2.96
88	1.03	1.26	1.68	1.97	2.30	2.64	2.93
89	1.02	1.25	1.68	1.95	2.28	2.62	2.91
90	1.01	1.24	1.66	1.93	2.26	2.59	2.88

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
91	1.00	1.23	1.65	1.92	2.24	2.57	2.86
92	1.00	1.22	1.63	1.90	2.22	2.55	2.83
93	0.99	1.21	1.62	1.89	2.20	2.53	2.81
94	0.98	1.20	1.61	1.87	2.19	2.51	2.79
95	0.97	1.19	1.59	1.85	2.17	2.49	2.76
96	0.96	1.18	1.58	1.84	2.15	2.46	2.74
97	0.96	1.17	1.57	1.82	2.13	2.44	2.72
98	0.95	1.16	1.56	1.81	2.12	2.42	2.70
99	0.94	1.15	1.54	1.80	2.10	2.41	2.67
100	0.93	1.14	1.53	1.78	2.08	2.39	2.65
101	0.93	1.13	1.52	1.77	2.07	2.39	2.65
102	0.92	1.13	1.51	1.75	2.05	2.35	2.61
103	0.91	1.12	1.50	1.74	2.04	2.33	2.59
104	0.90	1.11	1.49	1.73	2.02	2.31	2.57
105	0.90	1.10	1.47	1.72	2.01	2.30	2.55
106	0.89	1.09	1.46	1.70	1.99	2.28	2.54
107	0.88	1.09	1.45	1.69	1.98	2.26	2.52
108	0.88	1.08	1.44	1.68	1.96	2.25	2.50
109	0.87	1.07	1.43	1.67	1.95	2.23	2.48
110	0.87	1.06	1.42	1.65	1.93	2.21	2.46
111	0.86	1.06	1.41	1.64	1.92	2.20	2.45
112	0.85	1.05	1.40	1.63	1.91	2.18	2.43
113	0.85	1.04	1.39	1.62	1.89	2.17	2.41
114	0.84	1.03	1.38	1.61	1.88	2.15	2.40
115	0.84	1.03	1.37	1.60	1.87	2.14	2.38
116	0.83	1.02	1.36	1.59	1.86	2.12	2.36
117	0.82	1.01	1.36	1.58	1.84	2.11	2.35
118	0.82	1.01	1.35	1.57	1.83	2.09	2.33
119	0.81	1.00	1.34	1.56	1.82	2.08	2.32
120	0.81	0.99	1.33	1.55	1.81	2.07	2.30

DURATION IN HOURS	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
2	0.81	0.99	1.33	1.55	1.81	2.07	2.30
3	0.59	0.72	0.97	1.13	1.32	1.51	1.68
4	0.47	0.58	0.78	0.91	1.06	1.21	1.35
5	0.40	0.49	0.66	0.77	0.89	1.02	1.14
6	0.35	0.42	0.57	0.67	0.78	0.89	0.99
8	0.28	0.34	0.46	0.53	0.62	0.71	0.79
10	0.23	0.29	0.39	0.45	0.52	0.60	0.67
12	0.20	0.25	0.33	0.39	0.45	0.52	0.58
18	0.15	0.18	0.24	0.28	0.33	0.38	0.43
24	0.12	0.15	0.20	0.23	0.27	0.31	0.34

ATTACHMENT B

DRAINAGE CRITERIA MANUAL

INCREMENTAL INFILTRATION VALUES IN INCHES

Time Minutes**	SCS Hydrologic Soil Group A	B	C	D
5	.33	.26	.19	.12
10	.25	.17	.09	.04
15	.18	.11	.05	.02
20	.13	.07	.03	.02
25	.10	.05	.03	.02
30	.08	.05	.03	.02
35	.08	.05	.03	.02
40	.08	.05	.03	.02
45	.08	.05	.03	.02
50	.08	.05	.03	.02
55	.08	.05	.03	.02
60	.08	.05	.03	.02
65	.08	.05	.03	.02
70	.08	.05	.03	.02
75	.08	.05	.03	.02
80	.08	.05	.03	.02
85	.08	.05	.03	.02
90	.08	.05	.03	.02
95	.08	.05	.03	.02
100	.08	.05	.03	.02
105	.08	.05	.03	.02
110	.08	.05	.03	.02
115	.08	.05	.03	.02
120	.08	.05	.03	.02

**Time at end of the time increment

NOTE: Values for 125 minutes and additional 5 minute increments shall be the same as those shown for 120 minutes.

ATTACHMENT C

DRAINAGE CITERIA MANUAL

DEPRESSION STORAGE LOSSES

Surface Type	Total Loss (Inches)
Impervious:	
Paved Areas	0.1
Flat Roofs	0.1
Sloped Roofs	0.05
Pervious:	
Lawns and Grass	0.3
Wooded Areas and Open Fields	0.4

(3 pages)

ATTACHMENT D

DRAINAGE CRITERIA

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 rface 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	0.16	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 rface 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 basins 320 acres or larger.

ATTACHMENT E

DRAINAGE CRITERIA

AVERAGE OVERLAND FLOW VELOCITY FOR USE WITH URBANIZED AREAS

Surface Type	VELOCITY IN FEET/SECOND FOR SLOPES IN PERCENT SHOWN																			
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	20.0
Forest with Heavy Ground Litter or Meadow	0.03	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.16	0.21	0.28	0.33	0.39	0.46	0.53	0.60	0.72	1.10
Fallow or Minimum Tillage Cultivation	0.06	0.08	0.10	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.29	0.40	0.51	0.66	0.78	0.91	1.05	1.20	1.44	2.10
Short Grass Pasture or Lawns	0.09	0.13	0.15	0.18	0.20	0.21	0.23	0.25	0.26	0.28	0.45	0.60	0.77	0.96	1.17	1.33	1.50	1.68	1.98	3.20
Almost Bare Ground	0.16	0.22	0.28	0.31	0.35	0.38	0.41	0.44	0.46	0.49	0.70	0.85	1.05	1.26	1.50	1.75	2.03	2.32	2.79	4.40
Grassed Waterway	0.35	0.48	0.58	0.67	0.77	0.84	0.91	0.98	1.05	1.12	1.54	1.82	2.10	2.38	2.78	3.20	3.66	4.14	4.56	7.00
Paved Areas (Sheet Flow) or Shallow Gutter Flow	0.44	0.62	0.77	0.91	1.05	1.12	1.19	1.26	1.33	1.40	2.00	2.55	3.20	3.83	4.41	5.04	5.70	6.00	6.20	9.00

ATTACHMENT F

DETERMINATION OF DIMENSIONLESS WATERSHED CONVEYANCE FACTOR (Ø)

$$\emptyset = \emptyset_1 + \emptyset_2$$

$\emptyset_1$	Classification
0.6	Extensive channel improvement and storm sewer system, closed conduit channel system
0.7	Moderate channel improvement and storm sewer system.
0.8	Some channel improvement and storm sewers, mainly cleaning and enlargement of existing channel.
0.9	Little channel improvement and storm sewers.
1.0	Natural channel conditions.

$\emptyset_2$	Classification
0.0	No channel vegetation.
0.1	Light channel vegetation.
0.2	Moderate channel vegetation.
0.3	Heavy channel vegetation.

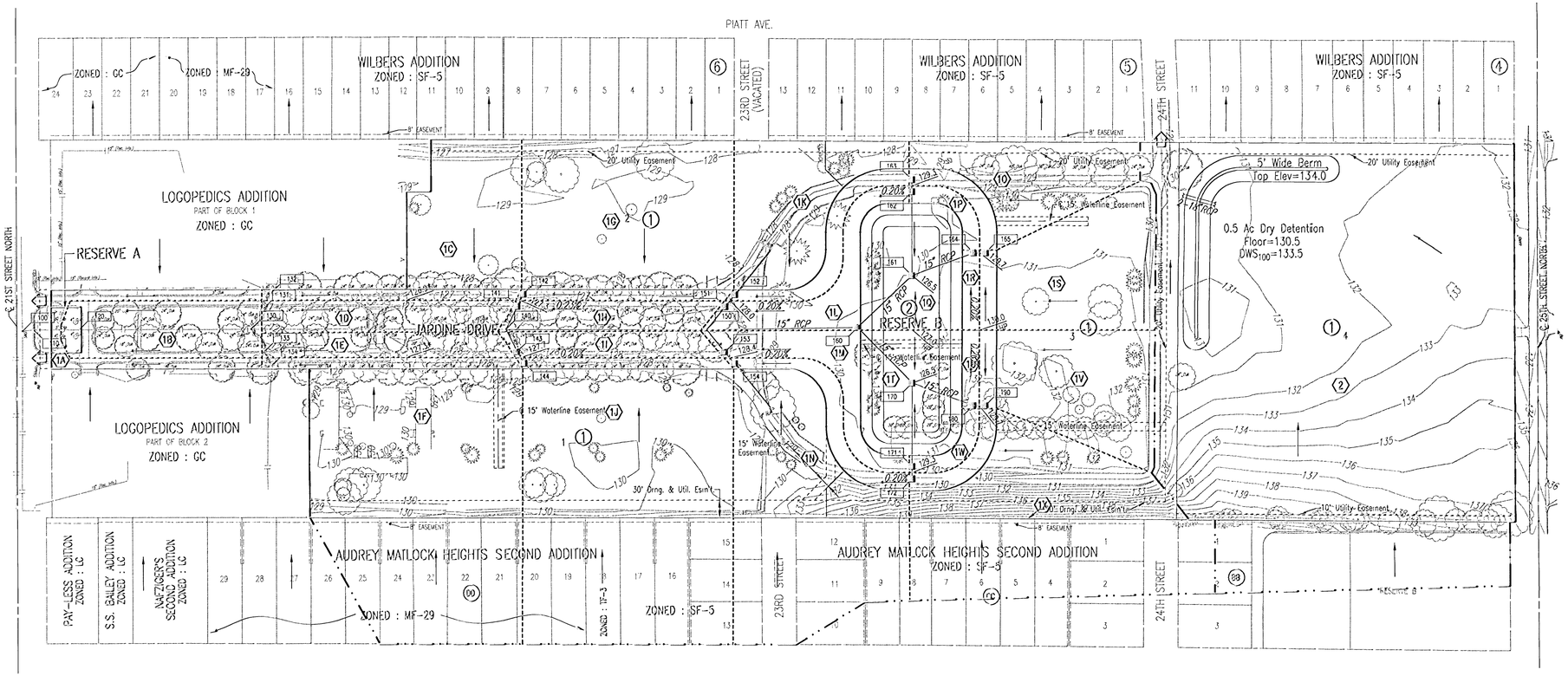
EXHIBIT NO. 1

SOIL LEGEND

SYMBOL	HYDROLOGIC GROUP	NAME
Aa	B	Albion-Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loans, 7 to 15 percent slopes
Ba	C	Blanket silt loam, 0 to 1 percent slopes
Bb	C	Blanket silt loan, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loan
Cb	B	Canadian-Waldeck fine sandy loams
Cc	D	Carwile fine sandy loam
Cd	B	Clark-Ost clay loams, 1 to 4 percent slopes
Ce	C	Clime silty clay, 3 to 6 percent slopes
Ea	B	Elandco silt loam
Eb	B	Elandco silt loam, occasionally flooded
Ec	B	Elandco silt loam, frequently flooded
Fa	B	Farnum loam, 0 to 1 percent slopes
Fb	B	Farnum loam, 1 to 3 percent slopes
Fc	B	Farnum loam, sandy substratum, 0 to 1 percent slopes
Ga	D	Goessel silty clay, 0 to 1 percent slopes
Gb	D	Goessel silty clay, 1 to 2 percent slopes
Ia	D	Irwin silty clay loam, 1 to 3 percent slopes
Ib	D	Irwin silty clay loam, 3 to 6 percent slopes
Ic	D	Irwin silty clay loam, 2 to 6 percent slopes, eroded
La	C	Lesho loam
Lb	A	Lincoln soils
Ma	B	Milan loam, 1 to 3 percent slopes
Mb	B	Milan form, 3 to 6 percent slopes
Mc	B	Milan clay loam, 2 to 6 percent slopes, eroded
Na	B	Naron fine sandy loam
Oc	D	Owens clay loam, 1 to 3 percent slopes
Od	D	Owens-Rock outcrop complex, 3 to 10 percent slopes
Pa		Pits
Pb	D	Plevna fine sandy loam
Pc	A	Pratt loamy fine sand, undulating
Pd	A	Pratt-Tivoli complex, rolling
Ra	D	Renfrow silty clay loam, 1 to 3 percent slopes
Rb	D	Renfrow silty clay loam, 3 to 6 percent slopes
Rc	D	Renfrow-Owens clay loams, 1 to 4 percent slopes
Rd	D	Rosehill silty clay, 1 to 3 percent slopes
Sa	B	Shellabarger sandy loam, 1 to 3 percent slopes
Sb	B	Shellabarger sandy loam, 3 to 6 percent slopes
Sc	B	Shellabarger sandy loam, 3 to 6 percent slopes, eroded
Ta	D	Tabler silty clay loam
Tb	D	Tabler-Drummond complex
Ua	B	Urban land-Canadian complex
Ub	B	Urban land-Elandco complex
Uc	B	Urban land-Farnum complex, 0 to 3 percent slopes
Ud	D	Urban land-Irwin complex, 1 to 3 percent slopes
Ue	D	Urban land-Tabler complex
Va	B	Vanoss silt loam, 0 to 1 percent slopes
Vb	B	Vanoss silt loam, 1 to 3 percent slopes
Vc	B	Vanoss silt loam, 3 to 6 percent slopes
Vd	B	Vanoss silt loam, 3 to 6 percent slopes, eroded
Ve	D	Vernon sandy loam, 1 to 3 percent slopes
Vf	D	Vernon sandy loam, 3 to 6 percent lopes
Wa	C	Waldeck sandy loam
Wb	D	Waurika silt loam

PLAN MAP

DRAINAGE PLAN
21ST STREET KIDS AND FAMILY EMPOWERMENT
AN ADDITION TO WICHITA, SEDGWICK COUNTY, KANSAS

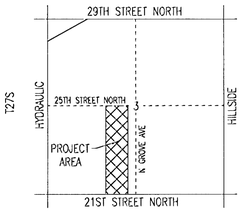


SCALE: 1" = 100'-0"

LEGEND

- (A) BASIN IDENTIFIER
- MAJOR BASIN BOUNDARY
- MINOR BASIN BOUNDARY
- MAJOR STORM WATER OVERFLOW (Q100)
- MINOR STORM WATER FLOW (Q2)
- 130 NODE IDENTIFIER
- 52.01 SPOT ELEVATION
- 52.01 HP HIGH POINT ELEVATION
- STORM SEWER AND INLET
- STORM SEWER AND MANHOLE

SEE SUPPORTING CALCULATIONS FOR HYDROLOGY



VICINITY MAP

BENCHMARKS:

BM #1:
CHISELED "a" ON BACK OF CURB ON THE NORTH SIDE OF 21ST ST. N. ±50' EAST OF ℄ JARDINE NORTH BOUND.
ELEV. = 127.54 CITY DATUM

BM#2:
3" T POST 0.5' BELOW GROUND CENTERED BETWEEN JARDINE NORTH AND SOUTH BOUND ±60' NORTH OF ℄ CROSS OVER ROAD ±620' NORTH OF ℄ 21ST ST. NORTH
ELEV. = 127.275 CITY DATUM

BM#3:
T POST ±.5" BELOW SURFACE, ±20' NORTH OF NORTH BACK OF CURB 23RD ST, ±℄ JARDINE.
ELEV. = 128.630 CITY DATUM

BM#4:
T POST BELOW SURFACE, ±20' NORTH OF NORTH BACK OF CURB OF 24TH ST., ±℄ JARDINE EXTENDED.
ELEV. = 130.265 CITY DATUM

BM#5:
CHISELED "a" TOP BACK OF CURB AT N.E. CORNER OF MADISON & 25TH ST. N., NORTH CURB RETURN AT NORTH CORNER OF WHEEL CHAIR RAMP.
ELEV. = 133.115 CITY DATUM

MINIMUM OPENINGS	ELEVATION (N.G.V.D.)	City Datum
BLOCK 1		
LOT 4	1322.4	135.0

REVISED 9-19-05

DSNR: BLB OPER: BLB SCALE: 1=100.00
Q:\2005\05-595\LDD\dwg\05-595-Drainage_Revised 09-20-2005 07:24:19 am