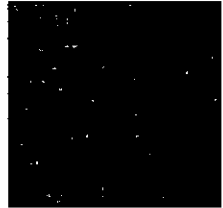


PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION



DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

HORSESHOE BAY ADDITION

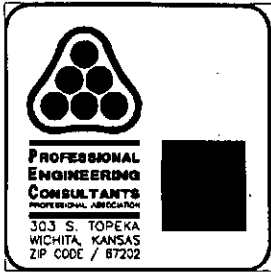
SCANNED

SCANNED

SEDGWICK COUNTY, KS

APRIL 28, 1996

303 S. TOPEKA
WICHITA, KANSAS 67202
(316) 262-2691
FAX (316) 262-3003



HORSESHOE BAY ADDITION **Wichita, Sedgwick County, Kansas**

4/29/96

Horseshoe Bay Addition is single family residential development in Northwest Wichita, Kansas encompassing approximately 10 acres. It is a replat of the West half of a development known as Horseshoe Lake. The computations and supporting data for the drainage plan of Horseshoe Bay Addition plat are presented herein.

Hydrology

The Rational Method has been used for hydrologic analysis of all storm sewer systems that serve the residential streets and yards. The analysis made is based on the available site data which includes the following: 1" = 100' topographic map with 2' contours of the site and adjacent areas; Sedgwick County Soil Survey Map; Wichita West Quadrangle Topographic Map; Horseshoe Lake Addition drainage plan dated July 24, 1995. Since nearly all lots abut a pond, back yard drainage systems will not be required for view out type lots, however, all lots in this plat lie within an area defined as Floodplain by FEMA's Floodway Map (See Design Aids Section) Based on a restudy of the Big Slough by Baughman Co., Les Eck's Lake has a base flood elevation of 1322.5 M.S.L. or 135.3 C.O.W. datum. Horseshoe Lake's base flood elevation is .5 ft lower but the only outlet is a 30" CMP in 21st North. Therefore, the emergency overflow for the lake is to be 21st Street North at an elevation of 1322.5 M.S.L. or 135.3 C.O.W. datum. In consideration of this, minimum opening will be 1324.7 M.S.L or 137.5 C.O.W. datum and low floor will be the 1323.5 M.S.L. or 136.3 C.O.W. datum. Additionally, the three proposed ponds will provide a 36" equalizer pipe to maintain equal elevations with the larger existing lakes.

Inlet Design

For local street conveyance, curb-deep flow is tolerable for the minor, or 2 year storm. For each inlet, street flooding and inlet capacity has been checked for the minor storm. It has been assumed 3/8 in./ft. street cross-slopes, City of Wichita 3-5/8" roll curb and gutter and Type 1A street inlets will be used throughout. Minimum walk grade has been assumed to be 0.3 feet above top of curb unless

otherwise noted. A "cascade effect" has been designed to provide a drainage release point in the event of system failure.

Pipe Design

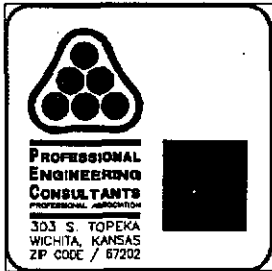
Hydraulic computations for the pipe system were performed using Manning's Equation. All pipes were assumed to be reinforced concrete with a Manning's "n" factor of 0.013. The hydraulic grade line is at least one foot below the top of curb elevations for the minor storm in all cases. The system is designed for the minor storm or 2 year storm, and has major storm overflow directed to sumps near the ponds.

To simplify analysis the following assumptions were made:

1. The time of concentration is identical for both pipe flow and street flow for both major and minor storm; a conservative estimate since pipe velocities generally exceed gutter velocities.

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.



HORSESHOE BAY ADDITION

HYDROLOGY

4/29/96

| BASIN # | AREA (ac) | C2 | C100 | tc | i2 (in/hr) | i100 (in/hr) | Q2 (cfs) | Q100 (cfs) |
|---------|-----------|------|------|----|------------|--------------|----------|------------|
| 1A | 1.15 | 0.44 | 0.61 | 15 | 3.83 | 7.37 | 1.95 | 5.21 |
| 1B | 1.10 | 0.44 | 0.61 | 15 | 3.83 | 7.37 | 1.87 | 4.98 |
| 1C | 1.50 | 0.44 | 0.61 | 15 | 3.83 | 7.37 | 2.55 | 6.80 |
| 1D | 0.50 | 0.44 | 0.61 | 15 | 3.83 | 7.37 | 0.85 | 2.27 |
| 2A | 2.15 | 0.44 | 0.61 | 15 | 3.83 | 7.37 | 3.65 | 9.74 |
| 2B | 0.75 | 0.44 | 0.61 | 15 | 3.83 | 7.37 | 1.27 | 3.40 |
| 2C | 1.30 | 0.44 | 0.61 | 15 | 3.83 | 7.37 | 2.21 | 5.89 |
| 2D | 0.55 | 0.44 | 0.61 | 15 | 3.83 | 7.37 | 0.93 | 2.49 |

otal Area= 9.00 Acres

Total Q2= 15.29 cfs

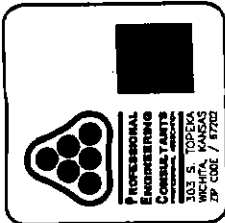
Total Q100= 40.78 cfs

Note : Runoff coefficient based on class B soils and 1/4 acre lots.

Comp by EDM

HORSESHOE BAY ADDITION STREET FLOW AND INLET DESIGN

4/29/96



Design Storm = Q 2 $z=(1/Sx)/n= 2000$

| Node/ Basin | Hydrology | | Approaching Flow | | | Inlet | | On-Grade Inlet | | Sump Inlet | | | Intercept Bypass | | | | |
|----------------|---------------------|----------------------|------------------------|-----------------------|-----------------|------------------|------|------------------|------------------------|------------|-----------------|-----------------------|----------------------|------------------|----------|----------|--|
| | Initial Qo (cfs) | Total Qo+Qb (cfs) | C&G Slope So (%) | X-Slope Sx (in/ft) | Depth d (ft) | Spread T (ft) | Type | Length L (ft) | Slot Length Lt (ft) | L/Lt | Efficiency E | Sump Depth di (ft) | Curb Depth d (ft) | Spread T (ft) | Qi (cfs) | Qb (cfs) | |
| 1B | 1.87 | | | 0.32 | 0.0313 | 0.27 | | | | | | | | | | | |
| 1D | 0.85 | | | 0.47 | 0.0313 | 0.18 | | 5 | | | | 0.25 | 0.09 | 2.73 | 2.72 | 0.00 | |
| 103 | | 2.72 | | | | | | | | | | | | | | | |
| 1A | 1.95 | | | 0.32 | 0.0313 | 0.27 | | | | | | | | | | | |
| 1C | 2.55 | | | 0.47 | 0.0313 | 0.28 | | 5 | | | | 0.37 | 0.21 | 6.59 | 4.50 | 0.00 | |
| 102 | | 4.50 | | | | | | | | | | | | | | | |
| 2B | 1.27 | | | 0.50 | 0.0313 | 0.21 | | | | | | | | | | | |
| 2C | 2.21 | | | 0.37 | 0.0313 | 0.28 | | 5 | | | | 0.30 | 0.13 | 4.27 | 3.48 | 0.00 | |
| 203 | | 3.48 | | | | | | | | | | | | | | | |
| 2A | 3.65 | | | 0.50 | 0.0313 | 0.32 | | | | | | | | | | | |
| 2D | 0.93 | | | 0.37 | 0.0313 | 0.20 | | 5 | | | | 0.37 | 0.21 | 6.59 | 4.59 | 0.00 | |
| 202 | | 4.59 | | | | | | | | | | | | | | | |

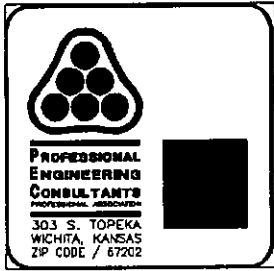
Maximum Street Flow by Manning's Equation
 58 ft R.O.W. 29 ft Street
 14.5 ft Parking 0.0208 Parking X-Slope
 0.302 Curb Height with 3 5/8 in. C.O.W. Roll Curb

$$Q_{max} = \frac{1.486}{n} AR^{2/3} \sqrt{S_o}$$

At Top of Curb:
 n (street) = 0.016
 n (curb) = 0.013
 Composite n = 0.0154
 Q2 = 4.42 cfs

At 0.302 ft. above Top of Curb (R.O.W.)
 n (parking) = 0.030
 n (street) = 0.016
 n (curb) = 0.013
 Composite n = 0.0226
 Q100 = 23.30 cfs

A = 2.92 ft²
 P = 19.94 ft
 R = 0.15
 A = 15.34 ft²
 P = 58.60 ft
 R = 0.26
 Q100 = 23.30 cfs



HORSESHOE BAY ADDITION PIPE SIZING ESTIMATES

4/29/96

Starting HGL Elev = 33 @ Outlet

| Begin Node | End Node | Length (ft) | Est. Dia. (in) | Bend (°) | Q2 (cfs) | T.C. Elev. (ft) | F.L. Elev. (ft) | Min Slope (%) |
|------------|----------|-------------|----------------|----------|----------|-----------------|-----------------|---------------|
| 104 | 103 | 160.0 | 15 | 20 | 0.00 | -- | 33.30 | 0.38 |
| 103 | 102 | 60.0 | 15 | 20 | 4.50 | 39.45 | 32.69 | 0.38 |
| 102 | 101 | 160.0 | 18 | 0 | 7.22 | 39.45 | 32.46 | 0.47 |
| 204 | 203 | 30.0 | 15 | 0 | 0.00 | -- | 32.80 | 0.38 |
| 203 | 202 | 60.0 | 15 | 0 | 4.59 | 39.45 | 32.69 | 0.38 |
| 202 | 201 | 160.0 | 18 | 0 | 8.07 | 39.45 | 32.46 | 0.59 |

Input File: hsb1

Horseshoe Bay Addition
 Wichita, Sedgwick County, Kansas
 PDM 4/28/96
 Line 1

Storm Frequency = 2-Year

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

| ***** | | | | | | | | | | | | | ***** | | | | ***** | | | | | | | |
|----------------|-----|------|-------|--------|-------|---------|-------|-------|---------|-------|-------|------|-----------|--------|--------|-------|-----------|--|--|--|--------------|--|--|--|
| Tributary Area | | | | | | | | | | | | | Hydrology | | | | Summation | | | | Conduit Data | | | |
| ***** | | | | | | | | | | | | | ***** | | | | ***** | | | | ***** | | | |
| Node to | C | Area | Slope | Length | TC(0) | I(0) | Q(0) | TC | I | Q | Sum Q | Size | Velocity | Length | TT | TT+TC | | | | | | | | |
| Node | | (Ac) | (%) | (Ft) | (Min) | (In/Hr) | (CFS) | (Min) | (In/Hr) | (CFS) | (CFS) | | (Ft/Sec) | (Ft) | (Min) | (Min) | | | | | | | | |
| ***** | | | | | | | | | | | | | ***** | | | | ***** | | | | | | | |
| 103 | 102 | .00 | .00 | .00 | .0 | 15.00 | 3.83 | 2.72 | 15.00 | 3.83 | 2.72 | 2.72 | 15" | 2.22 | 60.00 | .45 | 15.45 | | | | | | | |
| 102 | 101 | .00 | .00 | .00 | .0 | 15.00 | 3.83 | 4.50 | 15.45 | 3.78 | 4.44 | 7.16 | 18" | 4.05 | 160.00 | .66 | 16.11 | | | | | | | |
| ***** | | | | | | | | | | | | | ***** | | | | ***** | | | | | | | |

Date: 04-29-1996
Time: 09:10:37

Input File: hsb1

Horseshoe Bay Addition
Wichita, Sedgwick County, Kansas
PDM 4/28/96
Line 1

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

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*****
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| 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) |
|------|----------------------|------------------|--------------|--------------------|-----------------|--------------------|------------------|---------------|---------------------|----------------------|---------------|
| 103 | .00177 | .1064 | .0000 | .0000 | .0000 | .0000 | .0000 | .1064 | 34.3674 | 39.4500 | 5.08 |
| 102 | .00465 | .7433 | .0000 | .0179 | .0000 | .0063 | .4936 | 1.2610 | 34.2610 | 39.4500 | 5.19 |
| 101 | .00000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | 33.0000 | 33.0000 | .00 |

```
*****
```

Input File: hsb2

Horseshoe Bay Addition
 Wichita, Sedgwick County, Kansas
 PDM 4/28/96
 Line 2

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

| ***** | | | | | | | | | | ***** | | | | | ***** | | | | |
|----------------|-----|------|-------|--------|-------|---------|-------|-------|---------|---------------------|-------|------|----------|--------|--------------|-------|-------|--|--|
| Tributary Area | | | | | | | | | | Hydrology Summation | | | | | Conduit Data | | | | |
| ***** | | | | | | | | | | ***** | | | | | ***** | | | | |
| Node to | C | Area | Slope | Length | TC(0) | I(0) | Q(0) | TC | I | Q | Sum Q | Size | Velocity | Length | TT | TT+TC | | | |
| Node | | (Ac) | (%) | (Ft) | (Min) | (In/Hr) | (CFS) | (Min) | (In/Hr) | (CFS) | (CFS) | | (Ft/Sec) | (Ft) | (Min) | (Min) | | | |
| ***** | | | | | | | | | | ***** | | | | | ***** | | | | |
| 203 | 202 | .00 | .00 | .00 | .0 | 15.00 | 3.83 | 3.48 | 15.00 | 3.83 | 3.48 | 3.48 | 15" | 2.84 | 30.00 | .18 | 15.18 | | |
| 202 | 201 | .00 | .00 | .00 | .0 | 15.00 | 3.83 | 4.59 | 15.18 | 3.81 | 4.57 | 8.05 | 18" | 4.55 | 160.00 | .59 | 15.76 | | |
| ***** | | | | | | | | | | ***** | | | | | ***** | | | | |

Date: 04-29-1996

Time: 09:17:37

Input File: hsb2

Horseshoe Bay Addition
Wichita, Sedgwick County, Kansas
PDM 4/28/96
Line 2

Storm Frequency = 2-Year

* * * HYDRAULICS * * *

| 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) |
|------|----------------------|------------------|--------------|--------------------|-----------------|--------------------|------------------|---------------|---------------------|----------------------|---------------|
| 203 | .00290 | .0871 | .0000 | .0000 | .0000 | .0000 | .0000 | .0871 | 34.6236 | 39.4500 | 4.83 |
| 202 | .00587 | .9387 | .0000 | .0197 | .0000 | .0000 | .5781 | 1.5365 | 34.5365 | 39.4500 | 4.91 |
| 201 | .00000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | 33.0000 | 33.0000 | .00 |

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

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

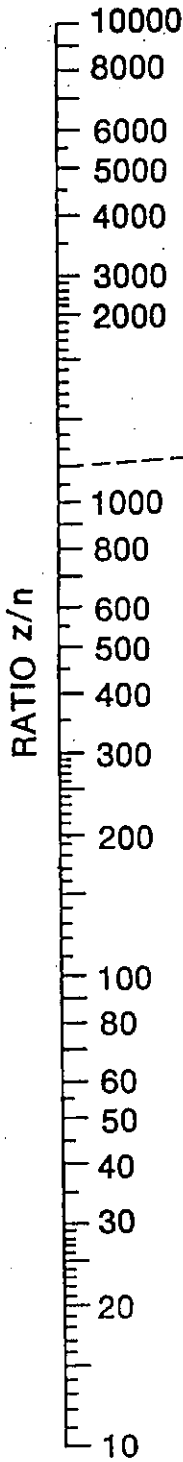
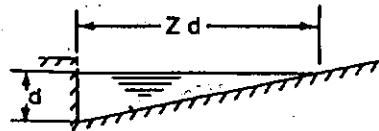
| Land Use or Surface Characteristics | Percent Impervious | Frequency | | | |
|--|-----------------------|-----------|------|------|------|
| | | 2 | 5 | 10 | 100 |
| 1. Business: | | | | | |
| Downtown Areas | 95 | 0.84 | 0.85 | 0.87 | 0.91 |
| Neighborhood Areas | 70 | 0.68 | 0.69 | 0.73 | 0.80 |
| 2. Residential: | | | | | |
| <u>Single Family (Soil Group D)</u> | | | | | |
| 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 |
| <u>Multi-Family (Soil Group D)</u> | | | | | |
| 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 |
| <u>Single Family (Soil Group C)</u> | | | | | |
| 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 |
| <u>Multi-Family (Soil Group C)</u> | | | | | |
| 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 |
| <u>Single-Family (Soil Group B)</u> | | | | | |
| 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 |
| <u>Multi-Family (Soil Group B)</u> | | | | | |
| 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 Face Characteristics | Percent Impervious | Frequency | | | |
|--|-----------------------|-----------|------|------|------|
| | | 2 | 5 | 10 | 100 |
| <u>Single Family (Soil Group A)</u> | | | | | |
| 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 |
| <u>Multi-Family (Soil Group A)</u> | | | | | |
| 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 |
| 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): | | | | | |
| <u>Soil Group A</u> | | | | | |
| 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 |
| <u>Soil Group B</u> | | | | | |
| 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 |
| <u>Soil Group C</u> | | | | | |
| 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 |

| <u>Land Use or Surface Characteristics</u> | <u>Percent Impervious</u> | <u>Frequency</u> | | | |
|--|-------------------------------|------------------|----------|-----------|------------|
| | | <u>2</u> | <u>5</u> | <u>10</u> | <u>100</u> |
| <u>Soil Group D</u> | | | | | |
| 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.



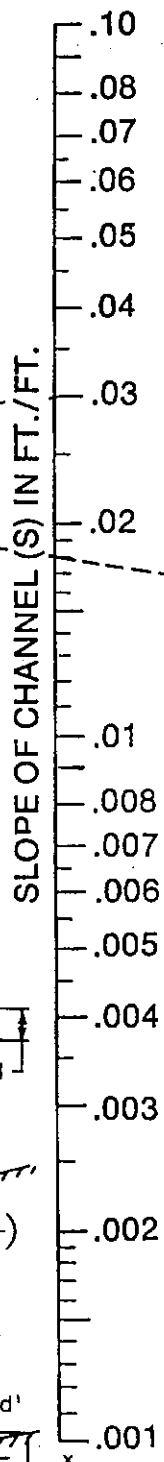
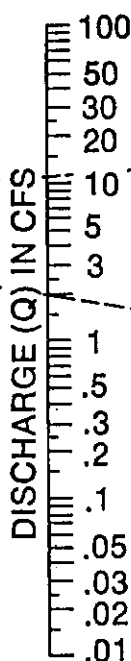
TURNING LINE

Equation: $Q = 0.56 \left(\frac{Z}{n}\right) s^{1/2} d^{3/2}$
 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 1946, page 150, equation (14)

Example (see dashed lines)
 Given: $s = 0.03$
 $z = 24$ } $z/n = 1200$
 $n = .02$
 $d = 0.22$

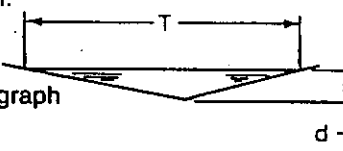
Find: $Q = 2.0$ CFS



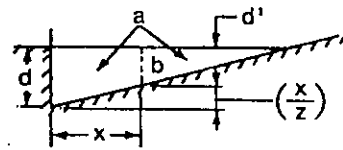
INSTRUCTIONS

1. Connect z/n ratio with slope (s) and connect discharge (Q) with depth (d). These two lines must intersect at turning line for complete solution.

2. For shallow v-shaped channel as shown use nomograph with $z = \frac{T}{d}$

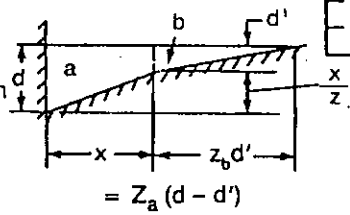


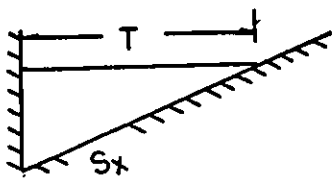
3. To determine discharge Q_x in portion of channel having width x : determine depth d for total discharge in entire section a . Then use nomograph to determine Q_b in section b for depth.



$$d' = d - \left(\frac{x}{z}\right)$$

4. To determine discharge in composite section: - follow instruction 3. To obtain discharge in section a at assumed depth d : obtain Q_b for slope ratio Z_b and depth d' , then $Q_T = Q_a \cdot Q_b$

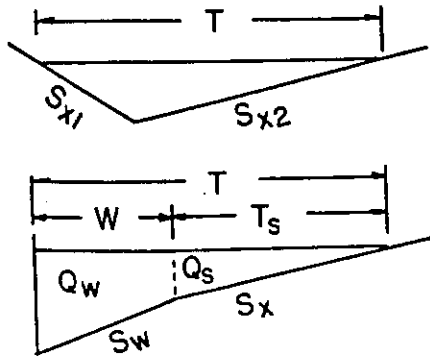
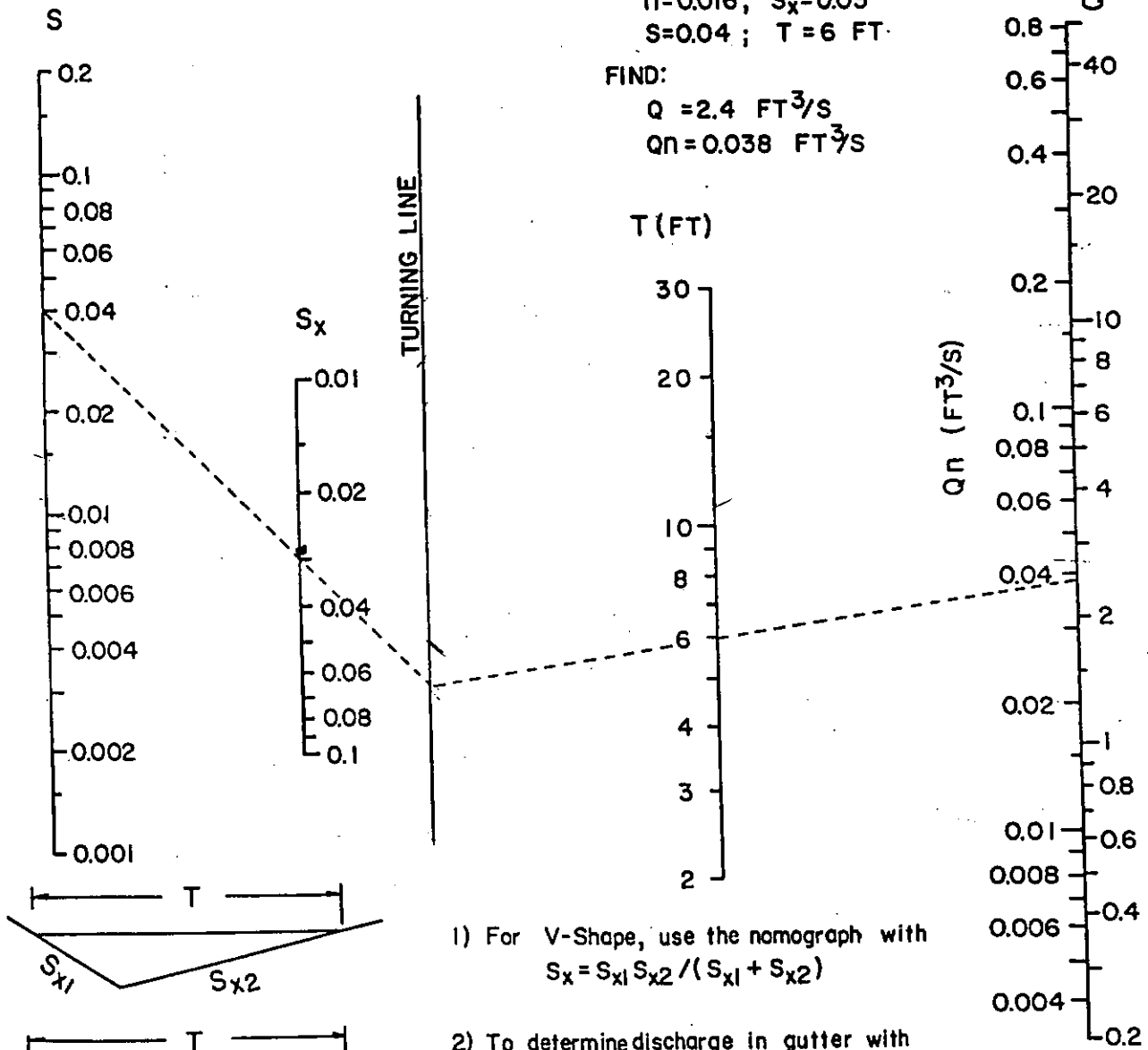




$$Q = \frac{0.56}{n} S_x^{1.67} S^{0.5} T^{2.67}$$

EXAMPLE: GIVEN:
 $n=0.016$; $S_x=0.03$
 $S=0.04$; $T=6$ FT.

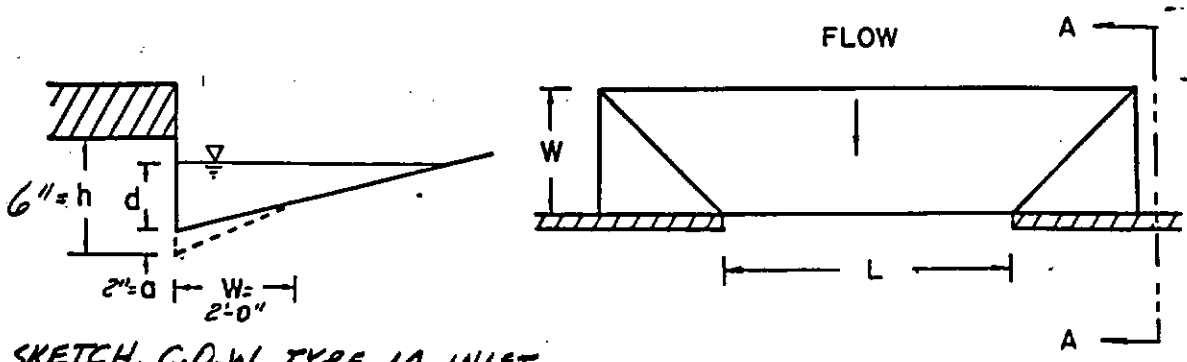
FIND:
 $Q = 2.4$ FT³/S
 $Qn = 0.038$ FT³/S



- 1) For V-Shape, use the nomograph with $S_x = S_{x1} S_{x2} / (S_{x1} + S_{x2})$
- 2) To determine discharge in gutter with composite cross slopes, find Q_s using T_s and S_x . Then, use CHART 4 to find E_o . The total discharge is $Q = Q_s / (1 - E_o)$, and $Q_w = Q - Q_s$.

CHART 3. Flow in triangular gutter sections.

From: HEC-12: DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., Mar. 1984



DEF. SKETCH, C.D.W. TYPE 1A INLET

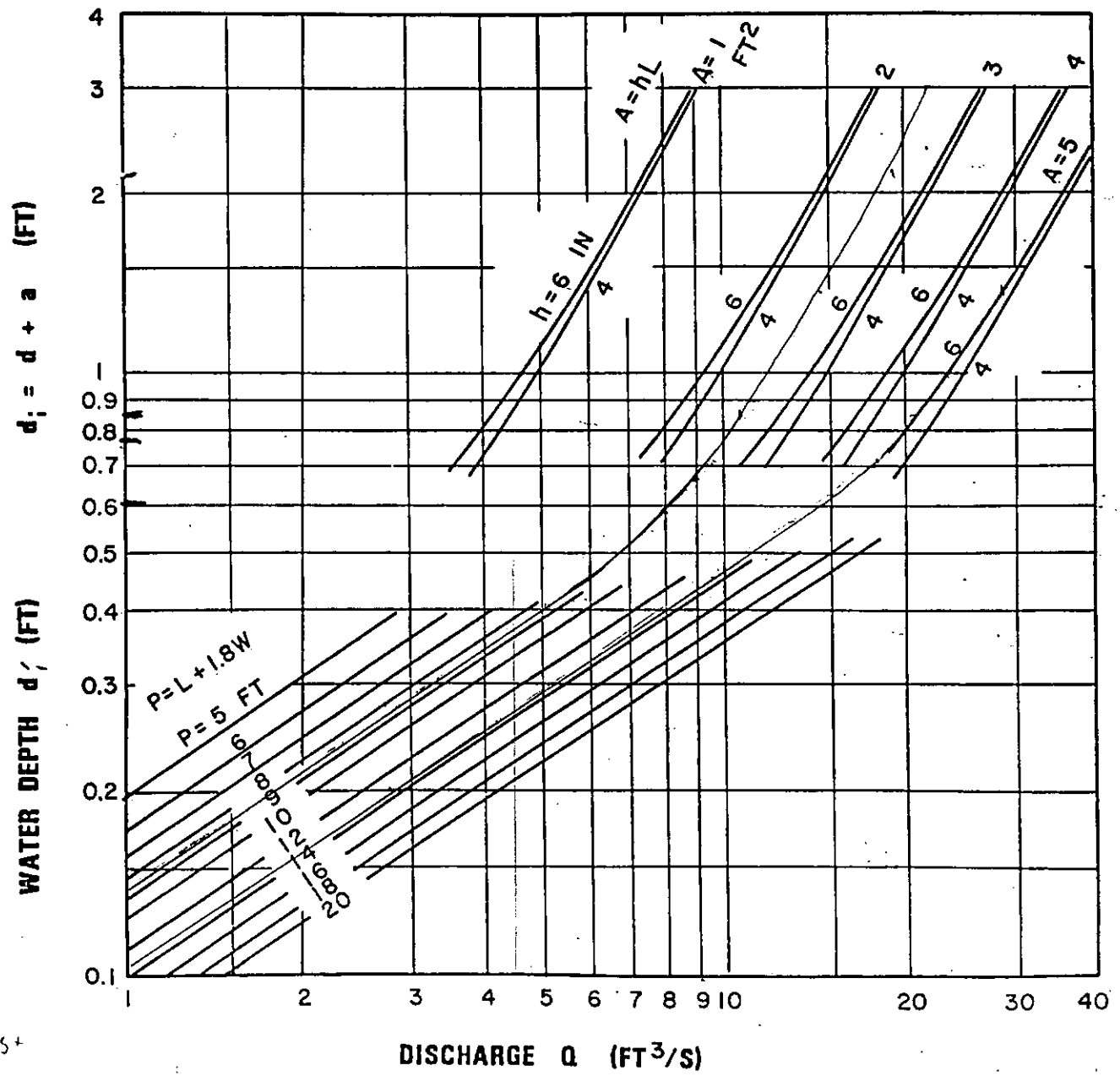


CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1984

$d_i = 5'$

April 15, 1986

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

CITY OF WICHITA, KANSAS

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

JDF

| DURATION IN MINUTES | RETURN PERIODS OF | | | | | | |
|------------------------|-------------------|------|------|-------|-------|-------|--------|
| | 1-YR | 2-YR | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| 5 | 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 |

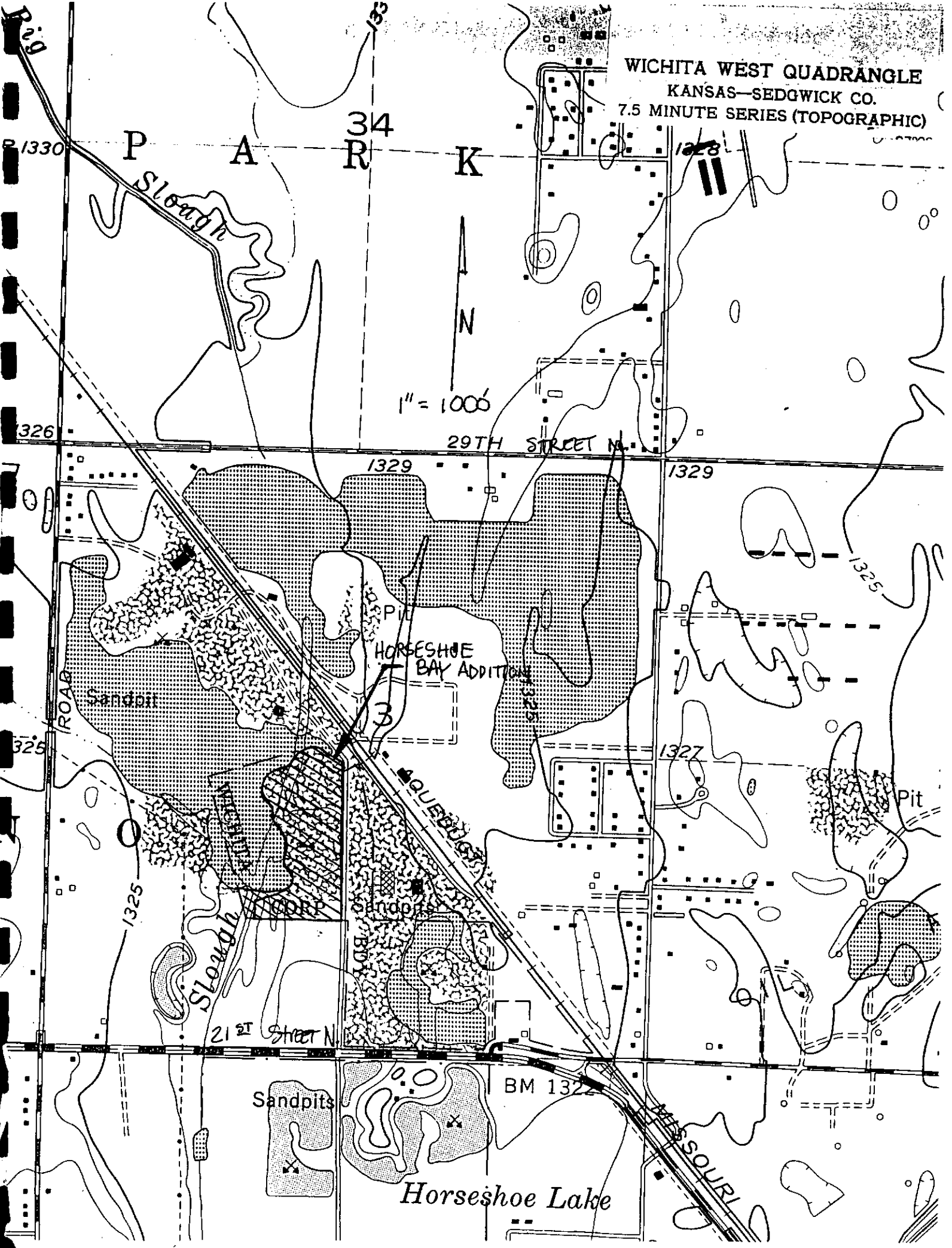
| DURATION IN MINUTES | RETURN PERIODS OF | | | | | | |
|------------------------|-------------------|------|------|-------|-------|-------|--------|
| | 1-YR | 2-YR | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| 46 | 1.70 | 2.05 | 2.54 | 2.97 | 3.48 | 3.93 | 4.33 |
| 47 | 1.67 | 2.02 | 2.50 | 2.93 | 3.44 | 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 | 3.64 |

TABLE 3
FULL FLOW COEFFICIENT VALUES
CIRCULAR CONCRETE PIPE

| D Pipe Diameter (inches) | A Area (Square Feet) | R Hydraulic Radius (Feet) | Value of $C_1 = \frac{1.486}{n} \times A \times R^{2.48} = K$ | | | |
|-----------------------------------|-------------------------------|------------------------------------|---|---------|---------|---------|
| | | | n=0.010 | n=0.011 | n=0.012 | n=0.013 |
| 8 | 0.349 | 0.167 | 15.8 | 14.3 | 13.1 | 12.1 |
| 10 | 0.545 | 0.208 | 28.4 | 25.8 | 23.6 | 21.8 |
| 12 | 0.785 | 0.250 | 46.4 | 42.1 | 38.6 | 35.7 |
| 15 | 1.227 | 0.312 | 84.1 | 76.5 | 70.1 | 64.7 |
| 18 | 1.767 | 0.375 | 137 | 124 | 114 | 105 |
| 21 | 2.405 | 0.437 | 206 | 187 | 172 | 158 |
| 24 | 3.142 | 0.500 | 294 | 267 | 245 | 226 |
| 27 | 3.976 | 0.562 | 402 | 366 | 335 | 310 |
| 30 | 4.909 | 0.625 | 533 | 485 | 444 | 410 |
| 33 | 5.940 | 0.688 | 686 | 624 | 574 | 530 |
| 36 | 7.069 | 0.750 | 867 | 788 | 722 | 666 |
| 42 | 9.621 | 0.875 | 1308 | 1189 | 1090 | 1006 |
| 48 | 12.566 | 1.000 | 1867 | 1698 | 1556 | 1436 |
| 54 | 15.904 | 1.125 | 2557 | 2325 | 2131 | 1967 |
| 60 | 19.635 | 1.250 | 3385 | 3077 | 2821 | 2604 |
| 66 | 23.758 | 1.375 | 4364 | 3967 | 3636 | 3357 |
| 72 | 28.274 | 1.500 | 5504 | 5004 | 4587 | 4234 |
| 78 | 33.183 | 1.625 | 6815 | 6195 | 5679 | 5242 |
| 84 | 38.485 | 1.750 | 8304 | 7549 | 6920 | 6388 |
| 90 | 44.170 | 1.875 | 9985 | 9078 | 8321 | 7681 |
| 96 | 50.266 | 2.000 | 11850 | 10780 | 9878 | 9119 |
| 102 | 56.745 | 2.125 | 13940 | 12670 | 11620 | 10720 |
| 108 | 63.617 | 2.250 | 16230 | 14760 | 13530 | 12490 |
| 114 | 70.882 | 2.375 | 18750 | 17040 | 15620 | 14420 |
| 120 | 78.540 | 2.500 | 21500 | 19540 | 17920 | 16540 |
| 126 | 86.590 | 2.625 | 24480 | 22260 | 20400 | 18830 |
| 132 | 95.033 | 2.750 | 27720 | 25200 | 23100 | 21330 |
| 138 | 103.870 | 2.875 | 31210 | 28370 | 26010 | 24010 |
| 144 | 113.100 | 3.000 | 34960 | 31780 | 29130 | 26890 |

$Q = K \sqrt{S}$
 $K = \frac{Q}{\sqrt{S}}$
 $S = \frac{Q^2}{K^2}$

WICHITA WEST QUADRANGLE
KANSAS—SEDGWICK CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



1" = 1000'

29TH STREET N

1329

1329

HORSESHOE BAY ADDITION

1327

21ST STREET N

BM 132

Horseshoe Lake

Sandpits

Pit

Sandpit

1330

34
R

K

P
A

1326

1325

1325

1325

Rig

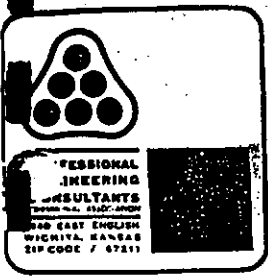
N

1278

ROAD

MOUEBUD

MISSOURI



Date June 17, 1982 Page 2 of 2

Project _____

Item Minimum Storm Drain Slopes

For Reinf. Conc. Pipe w/n = 0.013 find S_{min} for 2 fcs @ 0.2d

| d _o (in.) | S _{min} (%) | d _o (in.) | S _{min} (%) |
|----------------------|----------------------|----------------------|----------------------|
| 12 | 0.51 | 39 | 0.11 |
| 15 | 0.38 | 42 | 0.10 |
| 18 | 0.30 | 48 | 0.08 |
| 21 | 0.24 | 54 | 0.07 |
| 24 | 0.20 | 60 | 0.06 |
| 27 | 0.17 | 66 | 0.05 |
| 30 | 0.15 | 72 | 0.05 |
| 33 | 0.13 | 84 | 0.04 |
| 36 | 0.12 | 96 | 0.03 |

Pipe thickness
 $= \frac{d}{12} + 1" = t \text{ (in)}$

For CMP w/n as shown find S_{min} for 3 @ 2 fcs @ 0.2d

| d _o (in.) | Corrugations* | Manning's n (3) | S _{min} (%) 3 f.p.s. | S _{min} (%) 2 f.p.s. |
|----------------------|---------------|------------------------|-------------------------------|-------------------------------|
| 12 | H & C | 0.014 0.014 | 3.94 3.94 | 1.75 1.75 |
| 15 | H & C | 0.014 0.014 | 2.93 2.93 | 1.30 1.30 |
| 18 | H & C | 0.015 0.015 | 2.29 2.29 | 1.02 1.02 |
| 21 | H & C | 0.024 | 1.87 | 0.83 |
| 24 | H & C | 0.024 | 1.56 | 0.70 |
| 30 | H & C | 0.024 | 1.16 | 0.52 |
| 36 | H & C | 0.024 | 0.91 | 0.40 |
| 42 | H & C | 0.024 | 0.74 | 0.33 |
| 48 | H & C | 0.024 | 0.62 | 0.28 |
| 54 | H & C | 0.024 | 0.53 | 0.24 |
| 60 | C | 0.027 0.027 | 0.46 0.46 | 0.20 0.20 |
| 66 | C | 0.027 0.027 | 0.41 0.41 | 0.18 0.18 |
| 72 | C | 0.027 | 0.46 | 0.20 |
| 78 | C | 0.027 | 0.41 | 0.18 |
| 84 | C | 0.027 | 0.37 | 0.17 |
| 90 | C | 0.027 | 0.34 | 0.15 |
| 96 | C | 0.027 | 0.31 | 0.14 |

* C = Circumferential
 H = Helical

- ① 2 3/8 x 1/2 corrugations } from specifications
- ② 3 x 1 corrugations }
- ③ "N" from Section III.2.2 p. 11 "Interim Drainage & Stm. Sew. Policy for Design Criteria and Documentation - C.O.W., Ks. Adopted 4-15-86, Revised 11-01-86.

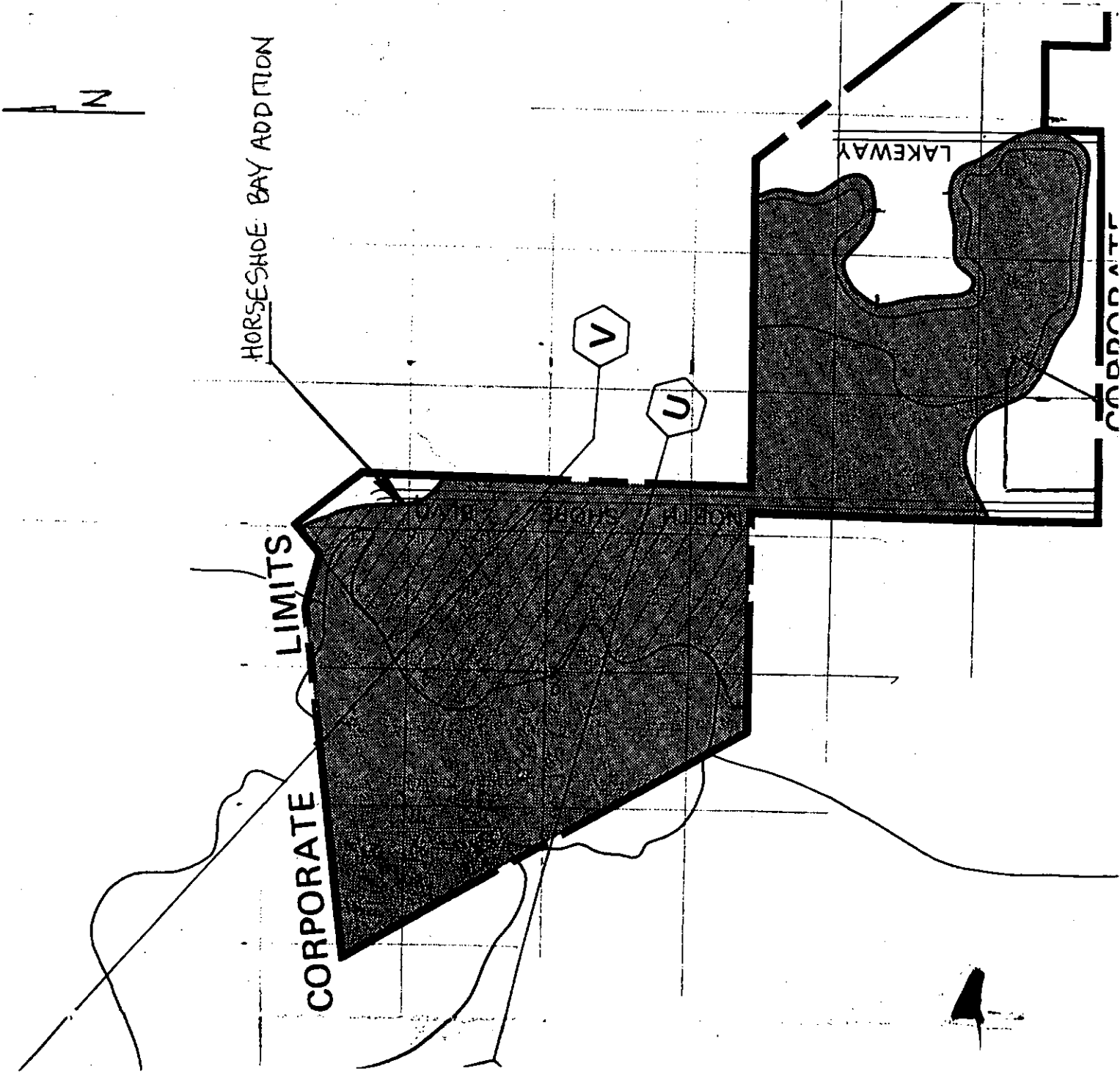
FLOODWAY FLOOD BOUNDARY AND FLOODWAY MAP

CITY OF
**WICHITA,
KANSAS**
SEDGWICK COUNTY

PANEL 5 OF 40
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
200328 0005

EFFECTIVE DATE:
MAY 15, 1966





SOIL SURVEY OF Sedgwick County, Kansas

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Kansas Agricultural Experiment Station

