# DRAINAGE PLAN
# AND
# SUPPORTING CALCULATIONS

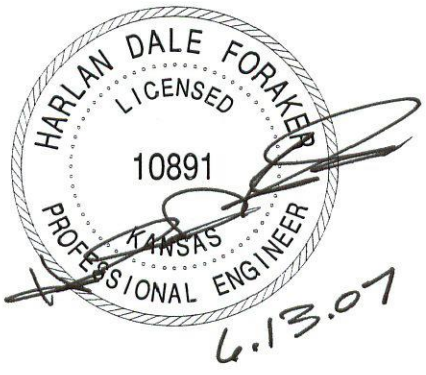
**FOR**
**NGUYEN ADDITION**
**WICHITA, KANSAS**

**PREPARED FOR:**
**MR. TOM NGUYEN.**
**4930 HARBORSIDE DRIVE**
**WICHITA, KS 67501**

**JUNE 13, 2007**

**PREPARED BY:**

**CERTIFIED ENGINEERING DESIGN, P.A.**
**810 WEST DOUGLAS, SUITE C**
**WICHITA, KANSAS 67203-6105**
**(316)262-8808 PHONE**
**(316)262-1669 FAX**



Adopted: February 23, 2007

CITY OF WICHITA

# Public Works, Engineering Division
# Final Drainage Plan Submittal Checklist

Reviewer: _____ Date: 6-11-07

Subdivision Name: NGUYEN ADDITION Location: 9801 EAST HARRY

Total Land Area Of Ownership: 2.43 Acres

Type: ____Residential ✓ Commercial ____Industrial ____Recreation ____Municipal ____Other

Applicant: TOM NGUYEN Contact: _____ Phone #: _____

Engineer: CERTIFIED ENG. DESIGN, P.A Contact: HARLAN FORAKER Phone # 316-267-8808

Please check the appropriate box: I = Included; NA = Non-Applicable; R= Required prior to development
*(If "NA" is checked, an explanation must be entered)*

| | Applicant | | | Engr | |
|---|---|---|---|---|---|
| **Tab 1. Project Narrative** | **I** | **NA** | **Explanation / Location in Plan** | **I** | **NA** |
| A. Site Location Map, using USGS Map | | | | ✓ | |
| B. Discussion of development, existing conditions, and proposed impacts on stormwater, wetland, riparian, and flood plain | | | | ✓ | |
| C. Discussion of offsite conditions | | | | ✓ | |
| D. Summary of runoff calculations (pre/post development) No increase in peak discharge for all storm series | | | | ✓ | |
| E. Narrative description of the type and function of the permanent best management practices that are incorporated into the site design | | | | ✓ | |
| F. Copy of the plat | | | | ✓ | |
| G. Preliminary grading plan (The final grading plan shall be sealed, signed and dated prior to Engineering receiving the final sanitary sewer plans. One plan sheet and PDF shall be submitted to the Subdivision Engineer.) | | | | ✓ | |
| H. Professional Engineer seal, signature and date on cover of report | | | | ✓ | |
| I. CD of drainage plan in PDF format (one file) and one paper copy bound with this checklist included behind the cover | | | | ✓ | |

| | Applicant | | | Engr | |
|---|---|---|---|---|---|
| **Tab 2. Existing Conditions Runoff Calculations** | **I** | **NA** | **Explanation / Location in Plan** | **I** | **NA** |
| A. Copy of applicable orthophoto showing proposed project boundaries (preferable in color) | | | | | |
| B. Runoff Method (Rational, Hydrograph Method, or other approved methods by Engineering) | | | | ✓ | |
| C. Existing topography (no greater than 2-foot contours, 1-foot recommend) | | | | ✓ | |
| D. Total Site Area and Total Impervious Area (acres) | | | | ✓ | |
| E. Benchmarks used for site control | | | | ✓ | |
| F. Streams, creeks, and waterway labeled | | | NO STREAMS ON-SITE. | | ✓ |
| G. Predominant soils from USDA soil surveys, and/or on site soil borings | | | | ✓ | |
| H. Location and boundaries of natural features such as wetlands, lakes, and ponds with the normal water elevation noted | | | NO WETLANDS, LAKES, PONDS PRESENT | | ✓ |
| I. Location of existing roads, buildings, parking lots and other impervious areas. | | | | ✓ | |



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| | | | | | |
|---|---|---|---|---|---|
| J. Location of existing utilities (e.g., water, sewer, gas, electric) and easements | | | | ✓ | |
| K. Location of existing conveyance systems such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow | | | | ✓ | |
| L. Flow paths | | | | ✓ | |
| M. Location and dimensions of existing channels, bridges or culvert crossings | | | | ✓ | |
| N. Existing conditions hydrologic analysis for runoff rates, volumes and velocities showing methodologies used and supporting calculations (2, 5, 10, 25 & 100 year, 24-hour storm events) or Critical Duration | | | | ✓ | |
| O. Assumed pre-developed runoff curve numbers | | | | ✓ | |
| P. Existing time of concentrations used in calculations | | | | ✓ | |
| Q. Evaluate immediate downstream drainage capacity, not to exceed more than 0.25 miles downstream of site | | | | | |
| R. Existing structural elevations (e.g., invert of pipes, manholes, etc.) | | | | ✓ | |
| S. Cross-section data for open channels | | | | | ✓ |
| T. Ground water elevations, if applicable | | | | | ✓ |

| | Applicant | | | Engr | |
|---|---|---|---|---|---|
| **Tab 3. Post-Development Hydrologic Analysis** | **I** | **NA** | **Explanation / Location in Plan** | **I** | **NA** |
| A. Proposed (post-development) conditions hydrologic and hydraulic analysis for runoff rates, volumes, HGL, and velocities showing the methodologies used and supporting calculations for all applicable design storms (2, 5, 10, 25 & 100 year, 24-hour storm events) | | | | ✓ | |
| B. Proposed time of concentrations used in calculations | | | | ✓ | |
| C. Assumed post-developed runoff curve numbers | | | | ✓ | |
| D. Proposed contours for detention facilities (to equal area used in outlet rating curves) | | | TO BE INCLUDED IN SITE GRADING DESIGN | | ✓ |
| E. Preliminary sizing calculations for stormwater controls including contributing drainage area, storage, and outlet configuration | | | 15" SWS OUTLET CONTROLS DISCHARGE | ✓ | |
| F. Stage-storage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities | | | TO BE INCLUDED IN SITE GRADING DESIGN | | ✓ |
| G. Final analysis of potential upstream/downstream impact/effects of project, where necessary | | | | ✓ | |
| H. Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.) | | | TO BE INCLUDED IN SITE GRADING DESIGN | | ✓ |
| I. Design water surface elevations and normal pool elevation for ponds. | | | | | ✓ |
| J. Typical detail for outlet structures, embankments, spillways, grade control structures, conveyance channels, etc. To include height, width, elevation, and/or diameter. | | | | ✓ | |
| K. Proposed limits of clearing and grading | | | | ✓ | |
| L. Location of existing and proposed roads, buildings, parking lots and other impervious areas. | | | | ✓ | |
| M. Location of existing and proposed utilities (e.g., water, sewer) and easements | | | WATER AND SEWER ARE EXISTING | | ✓ |
| N. Location of existing and proposed conveyance systems such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow | | | | ✓ | |
| O. Preliminary location and dimensions of proposed channel modifications, such as bridge or culvert crossings | | | NO CHANNELS OR BRIDGES | | ✓ |



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| | | | | | |
|---|---|---|---|---|---|
| P. Preliminary selection and location of stormwater controls | | | | | |
| Q. Emergency overflow structure's flow path | | | | | |
| R. Detention facility provides one-foot of freeboard above the HWL and emergency outfall shown (top of berm elevation shown) | | | | | |
| S. The 100-year 24-hour HWL delineated on the plan for detention pond | | | | | |
| T. Lowest opening elevations table on the plat for structures located adjacent to channels or ponds | | | | | |
| U. Stormwater Management Facilities located within a Reserve | | | | | |
| V. Maintenance responsibility of stormwater management facility shall be specified in the platters text. (e.g. HOA, Lot Owners Association, or lot) | | | | | |
| W. Off-site drainage easements or agreements required, where necessary | | | | | |

| | Applicant | | | Engr | |
|---|---|---|---|---|---|
| **Tab 4. Floodplain Submittal** | **I** | **NA** | **Explanation / Location in Plan** | **I** | **NA** |
| A. Provide source of flood profile | | | | | ✓ |
| B. Nearest base flood elevations | | | | | ✓ |
| C. Delineation of pre-developed regulatory floodplain/floodway limits | | | | | ✓ |
| D. Delineation of post-developed regulatory floodplain and floodway limits | | | | | ✓ |
| E. Floodplain boundary determination per elevation (project limits shown) | | | | | ✓ |
| F. Provide source of floodway data table and discharges | | | | | ✓ |
| G. Provide all hydrologic and hydraulic study information for site-specific floodplain studies, unnumbered Zone A area elevation determinations and flood plain map revisions or required permits | | | | | ✓ |
| H. Provide regulatory floodway and four natural profile models (10,50,100, and 500-yr) for existing and future watershed conditions | | | | | ✓ |
| I. Location of floodplain/floodway limits and relationship of site to upstream/downstream properties (floodplain limits to be per elevation and scaled location) | | | | | ✓ |
| J. Flood plains and floodways located within a Reserve, where necessary | | | | | ✓ |

| | Applicant | | | Engr | |
|---|---|---|---|---|---|
| **Tab 5. Federal, State and Local Permits (to be provided prior to construction unless otherwise specified)** | **I/R** | **NA** | **Explanation / Location in Plan** | **I/R** | **NA** |
| A. US Army Corps of Engineers - Regulatory program permits (404 water quality certification) | | | | | ✓ |
| B. Kansas Department of Agriculture - Division of Water Resources Permits (Stream Obstruction, Channel Change, Flood Plain Fill, Levee, Water Appropriations, Dam safety permit, etc.) | | | | | ✓ |
| C. Federal Emergency Management Agency (FEMA) Letter of Map Changes (LOMA, LOMR, LOMR-f, CLOMR, etc.) Shall be included and approved when project modifies the limits of the floodway. | | | | | ✓ |
| D. Kansas Department of Transportation | | | | | ✓ |
| E. Sedgwick County Right-of-way Permit | | | | | ✓ |



Consulting Engineer Initials HDF

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810 West Douglas,Suite C
Wichita, KS 67203-6105
(316)262-8808 Office
(316)262-1669 Fax

# *LETTER OF TRANSMITTAL*

DATE: June 11, 2007

TO: Ms. Vicky Huang, P.E.
Engineering Division
455 North Main
Wichita, KS 67202

RE: Drainage Plan
Nguyen Addition
Wichita, KS

FROM: Harlan D. Foraker, P.E. HDF

## I. PROJECT NARRATIVE

The site is located east of Webb Road on the south side of Harry Street at an address of 9801 East Harry Street and is currently undeveloped with native grass cover, some trees and the original farmhouse and a few outbuildings on the property. The predominant SCS soil type present within Nguyen Addition is Rosehill Silty Clay which is a SCS Type D Soil.

## II. EXISTING CONDITIONS RUNOFF CALCULATIONS

The rational method will be used to determine the peak discharges from the subareas of the study area. Rational 'C' Factors were assigned to the existing site and proposed improvements from "Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation" for the City of Wichita, Kansas.

The rainfall intensity tables for the Sedgwick County, Kansas which were obtained from the Kansas Department of Transportation were utilized to determine the rainfall intensity for the 5 and 100 year design storms.

The Soil Conservation Service TR-55 manual was used to compute the Time of Concentration for the drainage subareas. A design assumptions was made as follows that the minimum subarea time of concentration is 15 minutes

Soil types were determined from the SCS Soil Survey for Sedgwick County, Kansas.

The developed drainage subareas have been delineated on the 1" = 40' site and topographic mapping survey performed for this site.

Design Storm Events Evaluated: 2, 5, 10, 25, 50 and 100 yr. storm events

The runoff calculations for the street, drainage channel design, drainage pipe design and detention pond storage have been completed utilizing the 5 year storm. A check of the drainage system has been made using the 100 year storm event.

The following tables summarize the peak discharges for existing conditions for the offsite drainage subbasin of 2.70 acres and the subbasins within Nguyen Addition which have a total area of 2.43 acres.

| EXISTING PEAK RUNOFF | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Description | C | Tc | I | Area | Q(cfs) |
| Offsite Drainage Area(2 yr.) | .30 | 15 | 3.80 | 2.70 | 3.1 |
| Offsite Drainage Area(5 yr.) | .35 | 15 | 4.62 | 2.70 | 4.4 |
| Offsite Drainage Area(10 yr.) | .45 | 15 | 5.21 | 2.70 | 6.3 |
| Offsite Drainage Area(25 yr.) | .50 | 15 | 6.06 | 2.70 | 8.2 |
| Offsite Drainage Area(50 yr.) | .55 | 15 | 6.73 | 2.70 | 10.0 |
| Offsite Drainage Area(100 yr.) | .65 | 15 | 7.40 | 2.70 | 13.0 |
| | | | | | |
| Existing North SubArea(2 yr.) | .30 | 15 | 3.80 | 1.52 | 1.7 |
| Existing North SubArea(5 yr.) | .35 | 15 | 4.62 | 1.52 | 2.5 |
| Existing North SubArea(10 yr.) | .45 | 15 | 5.21 | 1.52 | 3.6 |
| Existing North SubArea(25 yr.) | .50 | 15 | 6.06 | 1.52 | 4.6 |
| Existing North SubArea(50 yr.) | .55 | 15 | 6.73 | 1.52 | 5.6 |
| Existing North SubArea(100 yr.) | .65 | 15 | 7.40 | 1.52 | 7.3 |
| | | | | | |
| Existing South SubArea(2 yr.) | .30 | 15 | 3.80 | 0.91 | 1.0 |
| Existing South SubArea(5 yr.) | .35 | 15 | 4.62 | 0.91 | 1.5 |
| Existing South SubArea(10 yr.) | .45 | 15 | 5.21 | 0.91 | 2.1 |
| Existing South SubArea(25 yr.) | .50 | 15 | 6.06 | 0.91 | 2.8 |
| Existing South SubArea(50 yr.) | .55 | 15 | 6.73 | 0.91 | 3.4 |
| Existing South SubArea(100 yr.) | .65 | 15 | 7.40 | 0.91 | 4.4 |
| | | | | | |

The existing drainage system which collects the runoff from the drainage site is an existing storm sewer system along the south side of Harry Street. It is a 36" reinforced concrete pipe with an unknown slope. At the minimum design slope of 0.12% the 36" RCP would have a capacity of 23.1 cubic feet per second. The existing 5 year storm event peak discharge for the north subbasin of 1.52 acres is 2.5 cfs. The existing 5 year storm event peak discharge for the south subbasin of 1.52 acres is 1.5 cfs.

## III. POST DEVELOPMENT HYDROLOGIC ANALYSIS

Design Storm Events Evaluated: 2, 5, 10, 25, 50 and 100 yr. storm events

The runoff calculations for the street, drainage channel design, drainage pipe design and detention pond storage have been completed utilizing the 5 year storm. A check of the drainage system has been made using the 100 year storm event.

Storm sewer was analyzed for full flow conditions was using "Flowmaster" by Haestad Methods Inc.

A detention analysis shall be performed in conjunction with design of the site grading plan during preparation of construction documents using the computer program by Hydraflow Hydrographs by Intellisolve.

The following tables summarize the peak discharges for developed conditions for the offsite drainage subbasin of 2.70 acres and the subbasins within Nguyen Addition which have a total area of 2.43 acres.

| **DEVELOPED PEAK RUNOFF** | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Description | C | Tc | I | Area | Q(cfs) |
| Offsite Drainage Area(2 yr.) | .30 | 15 | 3.80 | 2.70 | 3.1 |
| Offsite Drainage Area(5 yr.) | .35 | 15 | 4.62 | 2.70 | 4.4 |
| Offsite Drainage Area(10 yr.) | .45 | 15 | 5.21 | 2.70 | 6.3 |
| Offsite Drainage Area(25 yr.) | .50 | 15 | 6.06 | 2.70 | 8.2 |
| Offsite Drainage Area(50 yr.) | .55 | 15 | 6.73 | 2.70 | 10.0 |
| Offsite Drainage Area(100 yr.) | .65 | 15 | 7.40 | 2.70 | 13.0 |
| | | | | | |
| Developed North SubArea(2 yr.) | .68 | 15 | 3.80 | 1.52 | 4.0 |
| Developed North SubArea(5 yr.) | .69 | 15 | 4.62 | 1.52 | 4.8 |
| Developed North SubArea(10 yr.) | .73 | 15 | 5.21 | 1.52 | 5.8 |
| Developed North SubArea(25 yr.) | .75 | 15 | 6.06 | 1.52 | 6.9 |
| Developed North SubArea(50 yr.) | .78 | 15 | 6.73 | 1.52 | 8.0 |
| Developed North SubArea(100 yr.) | .80 | 15 | 7.40 | 1.52 | 9.0 |
| | | | | | |
| Developed South SubArea(2 yr.) | .68 | 15 | 3.80 | 0.91 | 2.4 |
| Developed South SubArea(5 yr.) | .69 | 15 | 4.62 | 0.91 | 2.9 |
| Developed South SubArea(10 yr.) | .73 | 15 | 5.21 | 0.91 | 3.5 |
| Developed South SubArea(25 yr.) | .75 | 15 | 6.06 | 0.91 | 4.1 |
| Developed South SubArea(50 yr.) | .78 | 15 | 6.73 | 0.91 | 4.8 |
| Developed South SubArea(100 yr.) | .80 | 15 | 7.40 | 0.91 | 5.4 |
| | | | | | |

The offsite drainage area which is located south of this site is currently unplatted. The general topography of the offsite property is from south to north and the sheet flow from this property would follow this same direction. A 20' wide portion of the unplatted area is located on the east side of this proposed plat. This unplatted strip of property should

serve as the drainage outlet for the offsite property and not require additional drainage easement to be set aside within the Nguyen Addition.

The first phase of the development for this site is the north subbasin which consists of parking lot and the proposed 13,000 square foot building. The developed peak discharge for the 5 year storm event is 4.8 cubic feet per second.

The second phase of the development is the south subbasin of 0.91 acres which consists of the parking lot and the 10,400 square foot building. The developed 5 year storm event peak discharge for the south subbasin is 2.9 cfs.

The combined peak developed discharge from the north and south subbasins is as follows:

| **COMBINED DEVELOPED** | | | | | |
|---|---|---|---|---|---|
| **PEAK DISCHARGE** | | | | | |
| Description | c | Tc | i | Area | Q(cfs) |
| Combined Developed SubArea(2 yr.) | .68 | 15 | 3.80 | 2.41 | 6.2 |
| Combined Developed SubArea(5 yr.) | .69 | 15 | 4.62 | 2.41 | 7.7 |
| Combined Developed SubArea(10 yr.) | .73 | 15 | 5.21 | 2.41 | 9.2 |
| Combined Developed SubArea(25 yr.) | .75 | 15 | 6.06 | 2.41 | 11.0 |
| Combined Developed SubArea(50 yr.) | .78 | 15 | 6.73 | 2.41 | 12.7 |
| Combined Developed SubArea(100 yr.) | .80 | 15 | 7.40 | 2.41 | 14.2 |
| | | | | | |

A curb inlet or 2'x4' drop inlet is proposed to be constructed in the northeast parking area of the front subbasin in order to collect the runoff from the 1.52 acres within the first phase of construction. The proposed 15" storm sewer will be extended under the pavement to the south edge of phase 1 to be utilized for collection of storm drainage from phase 2. A 15" storm sewer is proposed to convey the runoff from the proposed curb inlet to an existing curb inlet located in the south curb of Harry Street. A 15" RCP storm sewer at slope of 0.38% has a full flow capacity of 4.0 cubic feet per second.

The combined 5 year existing peak discharge for Nguyen Addition is 4.0 cfs which is comprised of 2.5 cfs for the north subbasin and 1.5 cfs for the south subbasin. The combined 5 year developed peak discharge for Nguyen Addition is 7.7 cfs which is 4.8 cfs for the north subbasin and 2.9 cfs for the south subbasin. The proposed 15" RCP storm sewer at a slope of 0.38% slope has a full flow capacity of 4.0 cfs and will limit the developed discharge to the combined existing peak discharge of 4.0 cfs.

| **DEVELOPED PEAK RUNOFF** | | | |
|---|---|---|---|
| **RESTRICTED BY 15" RCP SWS** | | | |
| | Exist. | Dev. | Restricted |
| Description | Q(cfs) | Q(cfs) | Q (cfs) |
| Combined SubArea(2 yr.) | 2.7 | 6.2 | 2.7 |
| Combined SubArea(5 yr.) | 4.0 | 7.7 | 4.0 |
| Combined SubArea(10 yr.) | 5.7 | 9.2 | 4.0 |
| Combined SubArea(25 yr.) | 7.4 | 11.0 | 4.0 |

| | | | |
|---|---|---|---|
| Combined SubArea(50 yr.) | 9.0 | 12.7 | 4.0 |
| Combined SubArea(100 yr.) | 11.7 | 14.2 | 4.0 |
| | | | |

The proposed 15" RCP storm sewer will provide the required restriction to limit the developed peak discharge to existing peak discharge for the 5 thru 100 year storm events. The required detention storage area shall be designed in the proposed site grading plan.

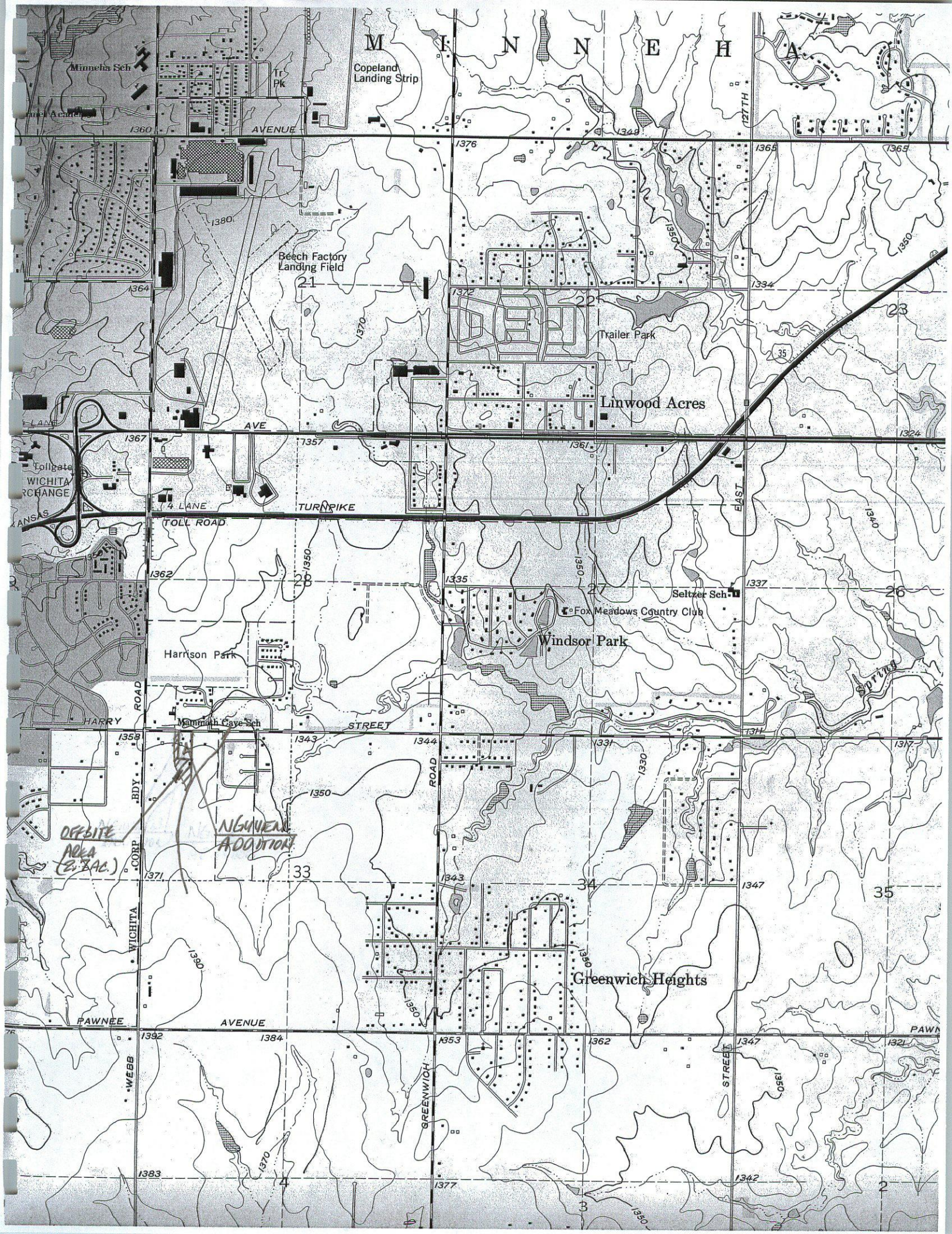
**IV. FLOODPLAIN SUBMITTAL** – No FEMA floodplain is located on this plat.

**V. FEDERAL, STATE AND LOCAL PERMITS**

A. US Army Corp of Engineers-Not Applicable
B. Kansas Dept. of Agriculture-Not Applicable
C. FEMA- Not Applicable
D. Kansas Department of Transportation-Not Applicable
E. Sedgwick County Right-of-Way Permit-Not Applcable

**VII. APPENDIX I:**

All charts, graphs, tables including a 1"=40' scale drainage plan map are included for review.


M I N N E H A
Minneha Sch
Tr Pk
Copeland Landing Strip
AVENUE
Beech Factory Landing Field
Trailer Park
Linwood Acres
AVE
Tollgate
WICHITA
TURNPIKE
TOLL ROAD
EAST
Seltzer Sch
Fox Meadows Country Club
Windsor Park
Harrison Park
HARRY
ROAD
Mammoth Cave Sch
STREET
BDY
CORP
WICHITA
OFFSITE AREA (2.2AC.)
NGUYEN ADDITION
Greenwich Heights
PAWNEE
AVENUE
WEBB
GREENWICH
STREET
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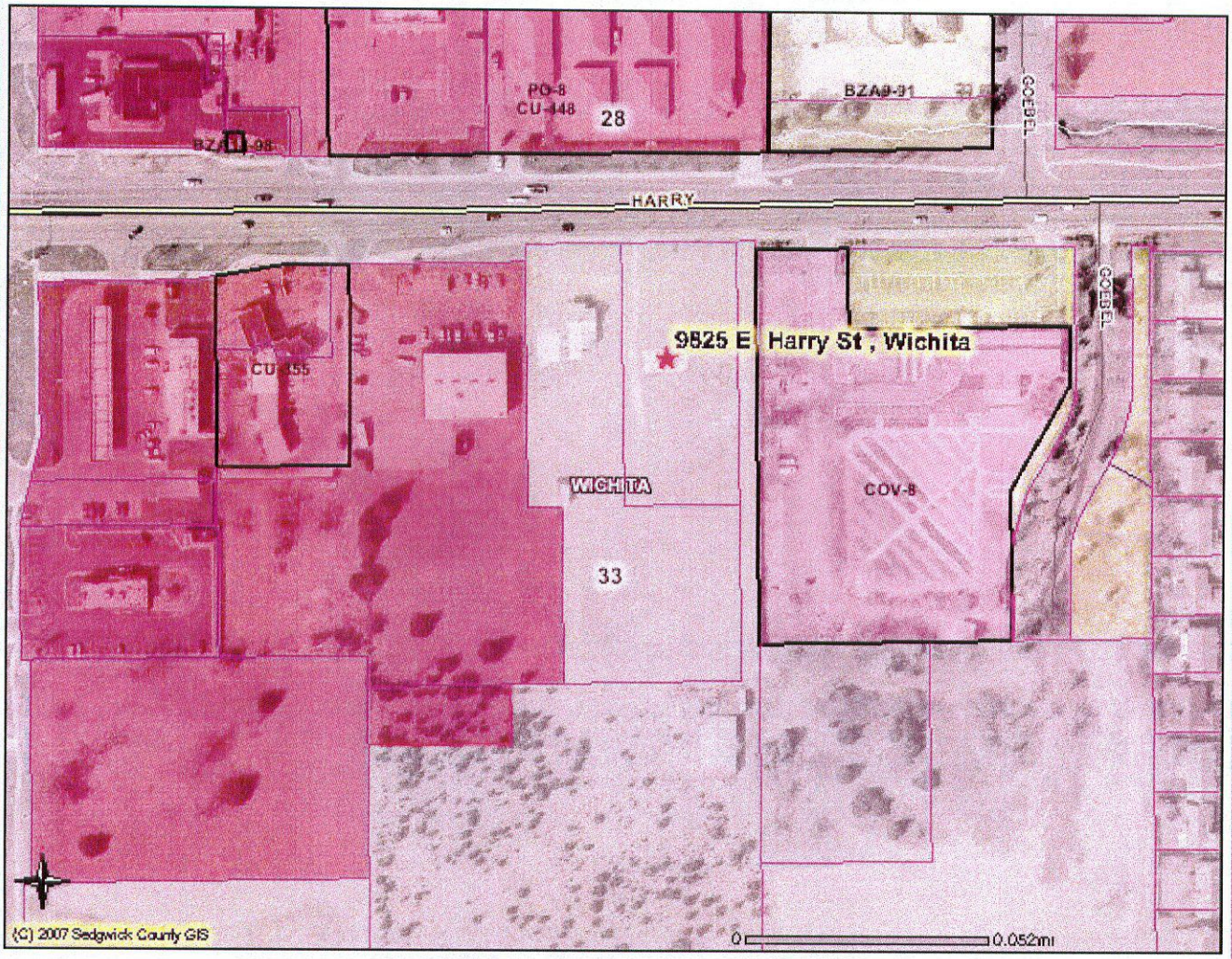
# Sedgwick County Maps




Legend

National Historic Site Buffers
500.0' Local Historic Site Buffers
1000' National Historic Site Buffers
Other
Historic Zoning Districts
National Historic Sites
Local Historic Sites
Roads
Highway
Highway Ramp
Major Roads
Other Roads
City Boundaries
ANDALE
BEL AIRE
BENTLEY
CHENEY
CLEARWATER
(cont)

COLWICH
DERBY
EASTBOROUGH
GARDEN PLAIN
GODDARD
HAYSVILLE
KECHI
MAIZE
MOUNT HOPE
MULVANE
PARK CITY
SEDGWICK
UNINCORPORATED
VALLEY CENTER
VIOLA
WICHITA
Other
Railroads
Rivers or Lakes
(cont)

Floodway
Rivers or Lakes
Minor Rivers
Square Mile Sections
Zoning Use Cases
Parcels
Zoning Districts
Unknown
Not Zoned
B - Multi-Family 75 d.u./Ac
CBD - Central Business District
GC - General Commercial
GI - General Industrial
GO - General Office
IP - Industrial Park
LC - Limited Commercial
LI - Limited Industrial
MF-18 - Multi-Family 18 d.u./Ac
MF-29 - Multi-Family 29 d.u./Ac
(cont)

MH - Manufactured Housing
NO - Neighborhood Office
NR - Neighborhood Retail
OW - Office/Warehouse
PUD - Planned Unit Developments
RR - Rural Residential
SF-10 - Single Family 10,000
SF-20 - Single Family 20,000
SF-5 - Single Family 5000
TF-3 - Two Family
U - University
Other
2006 aerial

Sedgwick County GIS

**Geographic Information Services**
Division of Information & Operations
www.sedgwickcounty.org/gis
525 N. Main, Suite 212, Wichita, KS 67203
Tel: 316.660.9290 Fax: 316.262.1174

TABLE I

INITIAL DESIGN STORM FREQUENCY

| Land Use | Initial Design Storm Return Period |
|---|---|
| 1. Residential and Public Park Areas | 2 years |
| 2. General Commercial Areas | 5 years |
| 3. Public Building Areas | 5 years |
| 4. Industrial Areas | 5 years |
| 5. High Value Downtown Business Areas | 5 years |
| 6. Major Airport Terminal Areas | 5 years |

TABLE II

ALLOWABLE PAVEMENT ENCROACHMENT FOR INITIAL DESIGN STORM

| Street Classification | Allowed Encroachment |
|---|---|
| 1. Local | No curb overtopping. Flow may spread across crown. |
| 2. Collector | No curb overtopping. One 8' lane width must be free of water. |
| 3. Arterial | No curb overtopping. One 8' through lane width in each direction must be free of water. |
| 4. Expressways and Freeways | No curb overtopping. Encroachment permitted in not more than one through lane width in each direction. |

was compatible

An additional requirement to the initial system criteria is that the runoff from the 100-year frequency major storm for time of concentrations identical to the initial system design must be retained within public rights-of-way in all cases. This 100-year frequency major storm requirement must be evaluated for projects in existing developed areas and when identified as prohibitive because of estimated costs, the consultant shall provide criteria recommendations to the City Engineer for such projects which will provide a reasonable cost/benefit ratio for the project.

C. Chapter 2 Comments and Modifications ~~"Precipitation"~~

1. Precipitation intensity for the various durations and frequencies shall be as shown in the table attached to this document and identified as "Attachment A". When intensities are required for durations not shown in the table in the range between 2-hour and 24-hour durations, such intensities shall be computed as straight line interpolations.

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

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

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

| Land Use or face 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 |
| 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 face 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.

# RAINFALL INTENSITY TABLE
SEDGWICK COUNTY
KANSAS

THIS TABLE CONTAINS AVERAGE RAINFALL INTENSITIES
IN INCHES PER HOUR.

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

# Full Flow Capacity of 36" RCP Storm Sewer @ 0.12%
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | Circular Channel |
| Flow Element | Circular Channel |
| Method | Manning's Formu |
| Solve For | Full Flow Capacit |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.013 | |
| Slope | 001200 | ft/ft |
| Diameter | 36 | in |

| Results | | |
|---|---|---|
| Depth | 3.00 | ft |
| Discharge | 23.10 | cfs |
| Flow Area | 7.1 | ft² |
| Wetted Perime | 9.42 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 1.55 | ft |
| Percent Full | 100.0 | % |
| Critical Slope | 004316 | ft/ft |
| Velocity | 3.27 | ft/s |
| Velocity Head | 0.17 | ft |
| Specific Energ | 3.17 | ft |
| Froude Numbe | 0.00 | |
| Maximum Disc | 24.85 | cfs |
| Discharge Full | 23.10 | cfs |
| Slope Full | 001200 | ft/ft |
| Flow Type | N/A | |



CERTIFIED ENGINEERING DESIGN
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

# Full Flow Capacity of 15" RCP Storm Sewer @ 0.38%
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | Circular Channel |
| Flow Element | Circular Channel |
| Method | Manning's Formu |
| Solve For | Full Flow Capacit |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.013 | |
| Slope | 003800 | ft/ft |
| Diameter | 15 | in |

| Results | | |
|---|---|---|
| Depth | 1.25 | ft |
| Discharge | 3.98 | cfs |
| Flow Area | 1.2 | ft² |
| Wetted Perime | 3.93 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 0.81 | ft |
| Percent Full | 100.0 | % |
| Critical Slope | 006758 | ft/ft |
| Velocity | 3.24 | ft/s |
| Velocity Head | 0.16 | ft |
| Specific Energ | 1.41 | ft |
| Froude Numbe | 0.00 | |
| Maximum Disc | 4.28 | cfs |
| Discharge Full | 3.98 | cfs |
| Slope Full | 003800 | ft/ft |
| Flow Type | N/A | |



CERTIFIED ENGINEERING DESIGN
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666