

DRAINAGE PLAN AND SUPPORTING CALCULATIONS

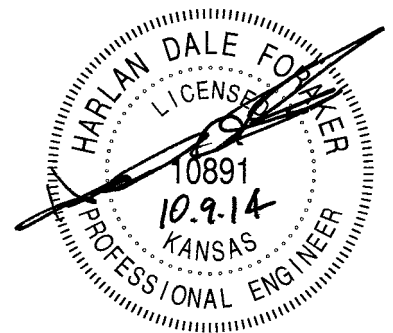
FOR

**CAMPBELL'S GREENHOUSE ADDITION
SW ¼ OF SECTION 9, T28S, R1E
SEDGWICK COUNTY, KS**

**PREPARED FOR:
SAVOY COMPANY, P.A.
433 S. HYDRAULIC ST.
WICHITA, KS 67211**

OCTOBER 9TH, 2014

**PREPARED BY:
CERTIFIED ENGINEERING DESIGN, P.A.
1935 WEST MAPLE
WICHITA, KANSAS 67213-3311
(316)262-8808 PHONE
(316)262-1669 FAX**



Mr. Scott Lindebak, P.E. (Con't)
Campbell's Greenhouse Addition
October 9th, 2014

CERTIFIED ENGINEERING DESIGN, P.A

1935 West Maple
Wichita, KS 67213-3311
(316)262-8808 Office
(316)262-1669 Fax

LETTER OF TRANSMITTAL

DATE: October 9th, 2014

TO: Mr. Scott Lindebak, P.E.
Storm Water Engineer
City of Wichita
8th Floor
455 N. Main
Wichita, KS 67202

RE: Drainage Plan
Campbell's Greenhouse Addition
Wichita, KS

FROM: Harlan D. Foraker, P.E.

cc: Mark Savoy, Savoy Company, P.A.

I. TAB 1 – PROJECT NARRATIVE:

Discussion of Development

The goal of this report is to analyze the existing drainage patterns and design the proposed drainage system to serve the Campbell's Greenhouse Addition site in Wichita, KS. This site is located approximately 500 ft north of the intersection of E. 37th St. and Topeka St. and located on the east side of the road. The west side of the site is developed with several greenhouses and the east side of the site is undeveloped with native grass cover.

The SCS soil types present on the site are the Saltcreek and Naron Fine Sandy Loams (SCS Type C Soil) and Canadian Fine Sandy Loam (SCS Type B Soil). There are no plans now or in the future to further develop this property. However, at the time of any future development, a site specific drainage plan shall be submitted to the city engineer prior to development. The plan shall comply with Chapter 16.32 of the City Code, which includes storm water detention and water quality treatment. The total area of the property is approximately 6.45 acres. An aerial photograph of the proposed plat site is located in the Appendix.

Offsite Conditions

It appears that there is a small amount of offsite drainage entering the site from the surrounding properties to the north. At the time of future development, it is critical to

Mr. Scott Lindebak, P.E. (Con't)
 Campbell's Greenhouse Addition
 October 9th, 2014

not obstruct this offsite drainage from flowing through or into Campbell's Greenhouse Addition property.

Description of Best Management Practices

The proposed plat site is only being platted. Therefore there are no best management practices incorporated into the site design at this time.

Summary of Runoff Calculations

The only calculations computed for the plat are existing peak runoff calculations. There are no proposed improvements to the property, and therefore no developed peak runoff calculations to compare. Table 1 shows existing peak runoff calculations.

Existing Peak Runoff							
Description	Percent Impervious (%)	SCS Soil Type (%)	C	Tc	I (in./hr)	Area (acres)	Q (cfs)
Existing Basin A (2 yr.)	40	B (60)	0.47	27	2.40	6.45	7.28
Existing Basin A 5 yr.)			0.48	27	3.02	6.45	9.35
Existing Basin A (10 yr.)			0.52	27	3.50	6.45	11.74
Existing Basin A (25 yr.)			0.53	27	4.12	6.45	14.08
Existing Basin A (100 yr.)			0.60	27	5.06	6.45	19.58

Table 1 – Existing Peak Runoff Calculations

II. TAB 2 – EXISTING CONDITIONS INFORMATION

Runoff Method

The rational method was used to compute the peak discharges for existing conditions. Rational 'C' factors were assigned to the existing site from the City of Wichita Storm Water Manual. Rainfall intensity tables from the same manual were utilized to determine the rainfall intensity for the 2, 5, 10, 25, and 100 year design storms. The Soil Conservation Service TR-55 manual was used to compute the time of concentration for the drainage areas. A design assumption was made as follows: that the minimum time of concentration is 15 minutes. Time of concentration calculations can be seen in the Appendix for each sub-basin.

Soil Types were determined from the Natural Resource Conservation Soil Survey website. The SCS soil types present on the site are the Saltcreek and Naron Fine Sandy Loams (SCS Type C Soil) and Canadian Fine Sandy Loam (SCS Type B Soil).

Existing Conditions

The entire existing 6.45 acre site is outlined as existing basin A. Basin A sheet flows to the east and south where runoff exits the site and flows into multiple existing pond/depression areas south of the plat site. A summary of the existing drainage calculations can be seen in Table 2. The existing drainage basins can be seen on the Drainage Plan Map located in the Appendix.

Existing Peak Runoff							
Description	Percent Impervious (%)	SCS Soil Type (%)	C	Tc	I (in./hr)	Area (acres)	Q (cfs)
Existing Basin A (2 yr.)	40	B (60)	0.47	27	2.40	6.45	7.28
Existing Basin A 5 yr.)			0.48	27	3.02	6.45	9.35
Existing Basin A (10 yr.)			0.52	27	3.50	6.45	11.74
Existing Basin A (25 yr.)			0.53	27	4.12	6.45	14.08
Existing Basin A (100 yr.)			0.60	27	5.06	6.45	19.58

Table 2 – Existing Peak Runoff Calculations

Ground Water Elevations

According to the Kansas Geological Survey's Kansas Water Well Database, the static water surface depth of the ground water in this area is around 10-15 ft below the existing ground. A copy of the static water depth map for this area is located in the Appendix.

III. TAB 3 – DEVELOPED CONDITIONS INFORMATION

Developed Conditions

There are no plans now or in the future to develop this property, and no developed peak runoff calculations were computed. However, should circumstances change and future development be desired, a site specific drainage plan shall be submitted to the city engineer prior to development. The plan shall comply with Chapter 16.32 of the City Code, which includes storm water detention and water quality treatment. The reserve areas for any future detention pond(s) shall be recorded by separate instrument. Any future improvements shall not obstruct any offsite drainage that currently drains into/through the site.

Storm Water Quantity

There are currently no proposed improvements. Therefore no detention is required or shown.

Downstream Assessment Analysis

There are currently no proposed improvements. Therefore a downstream assessment analysis is not required.

Storm Water Quality

There are currently no proposed improvements. Therefore storm water quality is not required.

Channel Protection

There are currently no proposed improvements. Therefore channel protection is not required.

Mr. Scott Lindebak, P.E. (Con't)
Campbell's Greenhouse Addition
October 9th, 2014

IV. TAB 4 – FLOODPLAIN SUBMITTAL

FEMA Floodplain Boundary

The property is located in Zone X on the FEMA flood map (FIRM #2017C0365E). The base flood elevation for this property is 1279.6 (NAVD 88). Minimum pad elevations are set at a minimum 2' above the Base Flood Elevation. A copy of the FEMA floodplain map is attached for review in the Appendix.

V. TAB 5 – FEDERAL, STATE, AND LOCAL PERMITS

A. US Army Corps of Engineers

Not Applicable

B. Kansas Department of Agriculture

Not Applicable

C. Federal Emergency Management Agency (FEMA)

Not Applicable

D. Kansas Department of Transportation

Not Applicable

E. Sedgwick County Right-of-way Permit

Right-of-way Permit - Not Applicable

Storm Water Permit - Required

F. Kansas Department of Health and Environment

NOI - Required

Mr. Scott Lindebak, P.E. (Con't)
Campbell's Greenhouse Addition
October 9th, 2014

APPENDIX

Mr. Scott Lindebak, P.E. (Con't)
Campbell's Greenhouse Addition
October 9th, 2014

GENERAL MAPS

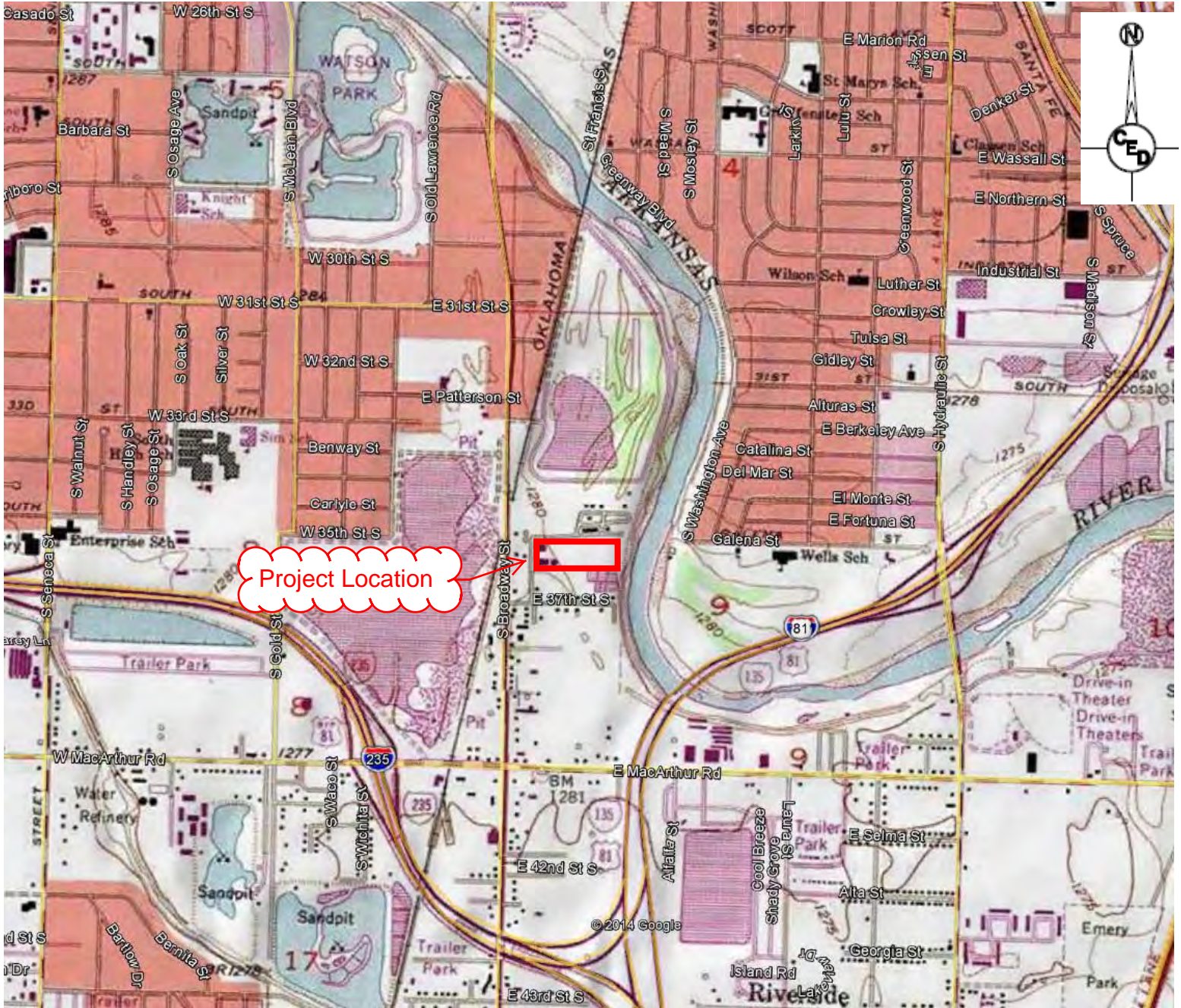
Aerial Photo

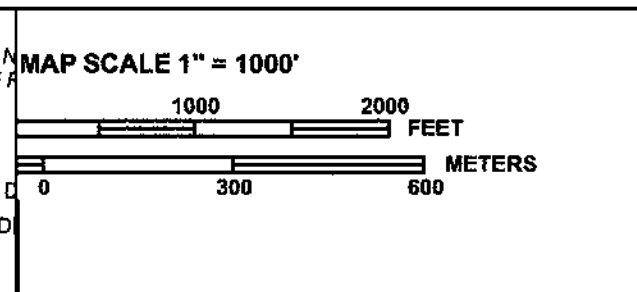
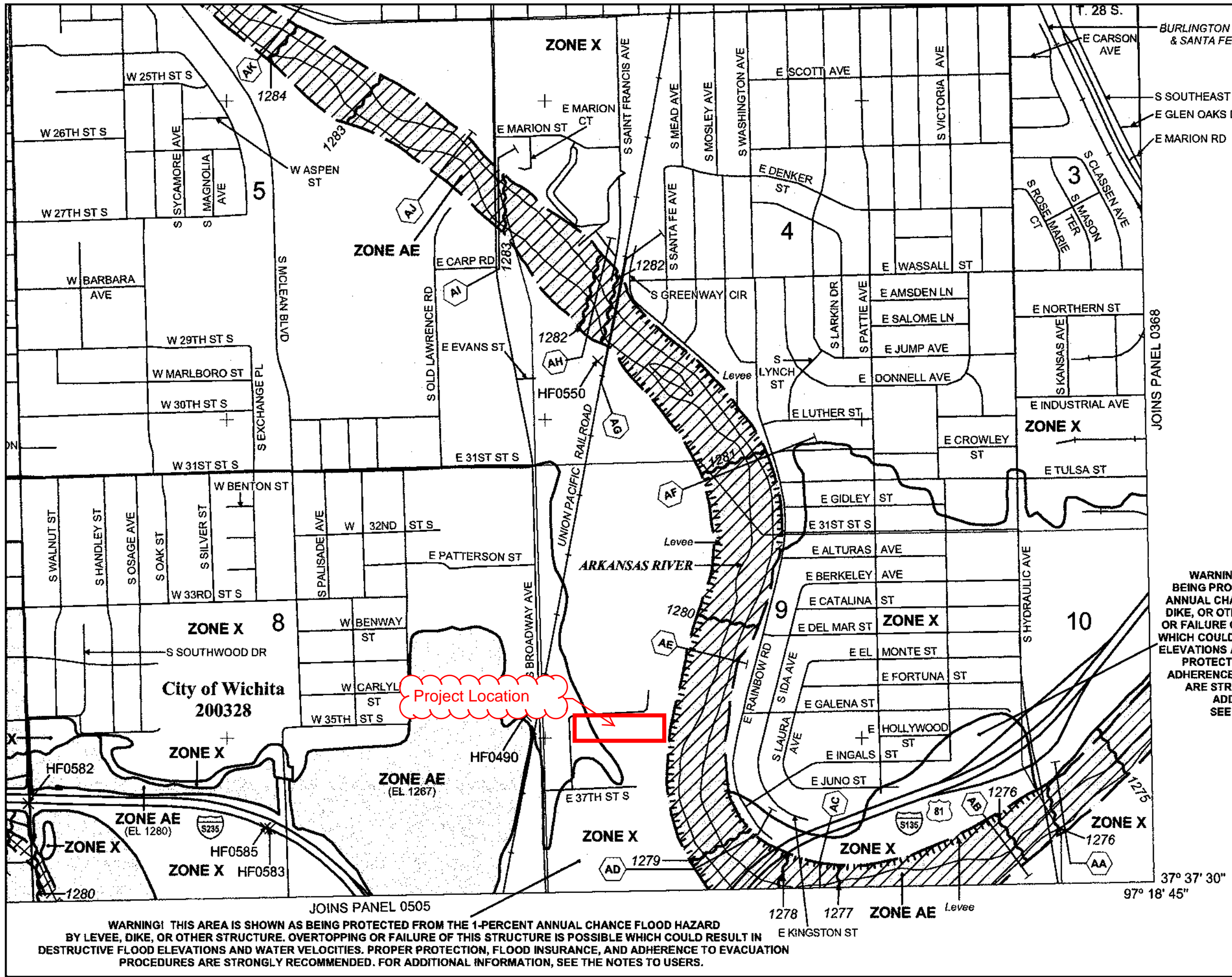
Campbell's Greenhouse Addition
SW ¼ of S9, T28S, R1E
Sedgwick County, Kansas
CED Job # 20142194



Quad Map

Campbell's Greenhouse Addition
SW ¼ of S9, T28S, R1E
Sedgwick County, Kansas
CED Job # 20142194





PANEL 0365E

FIRM
FLOOD INSURANCE RATE MAP
SEDGWICK COUNTY,
KANSAS
AND INCORPORATED AREAS

PANEL 365 OF 700
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SEDGWICK COUNTY	200321	0365	E
WICHITA, CITY OF	200328	0365	E

WARNING
 BEING PROTECTED FROM THE 1-PERCENT ANNUAL CHANCE FLOOD HAZARD BY LEVEE, DIKE, OR OTHER STRUCTURE. OVERTOPPING OR FAILURE OF THIS STRUCTURE IS POSSIBLE WHICH COULD RESULT IN DESTRUCTIVE FLOOD ELEVATIONS AND WATER VELOCITIES. PROPER PROTECTION, FLOOD INSURANCE, AND ADHERENCE TO EVACUATION PROCEDURES ARE STRONGLY RECOMMENDED. FOR ADDITIONAL INFORMATION, SEE THE NOTES TO USERS.

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
20173C0365E

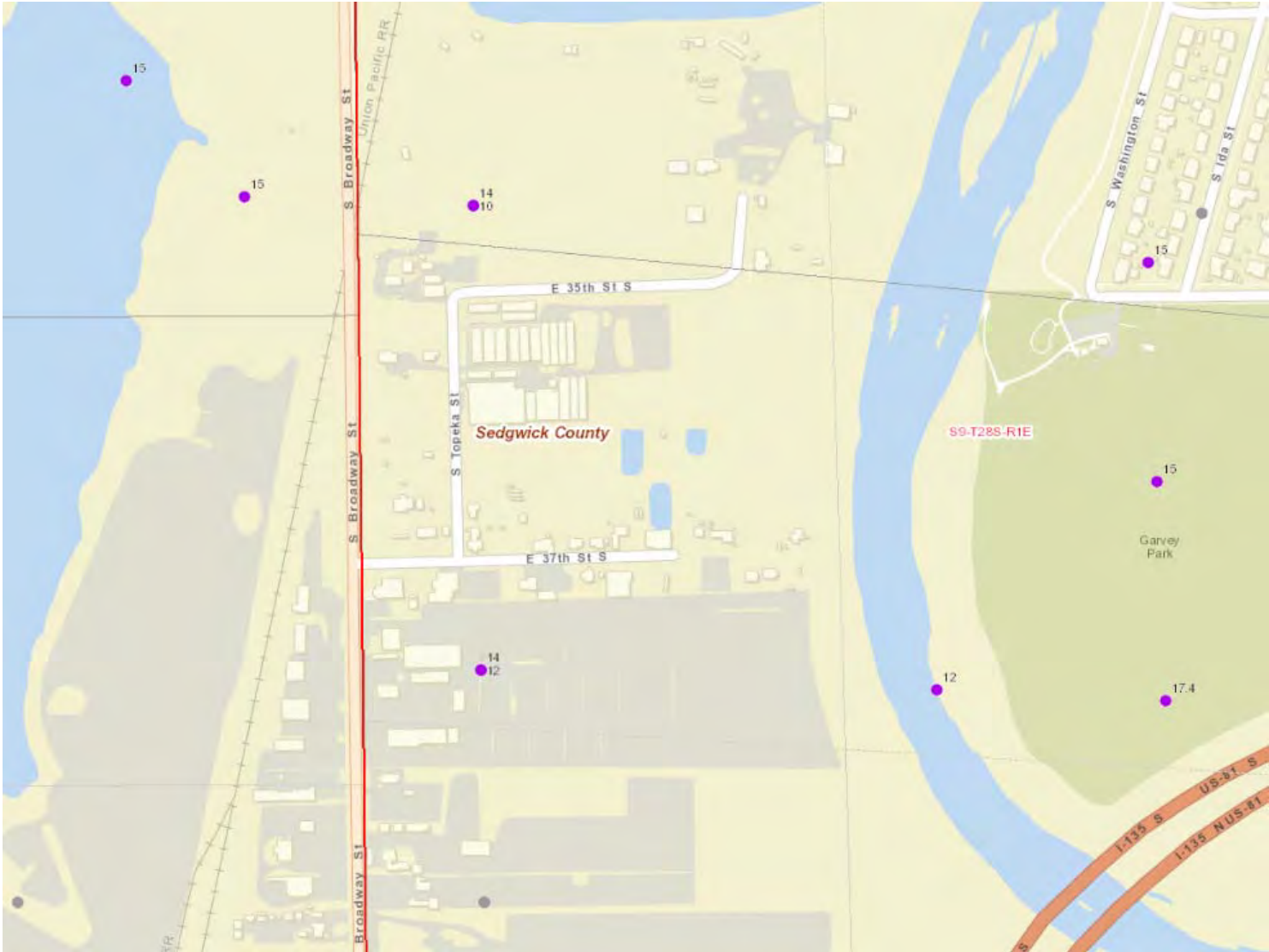
EFFECTIVE DATE
FEBRUARY 2, 2007

Federal Emergency Management Agency

WARNING! THIS AREA IS SHOWN AS BEING PROTECTED FROM THE 1-PERCENT ANNUAL CHANCE FLOOD HAZARD BY LEVEE, DIKE, OR OTHER STRUCTURE. OVERTOPPING OR FAILURE OF THIS STRUCTURE IS POSSIBLE WHICH COULD RESULT IN DESTRUCTIVE FLOOD ELEVATIONS AND WATER VELOCITIES. PROPER PROTECTION, FLOOD INSURANCE, AND ADHERENCE TO EVACUATION PROCEDURES ARE STRONGLY RECOMMENDED. FOR ADDITIONAL INFORMATION, SEE THE NOTES TO USERS.

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

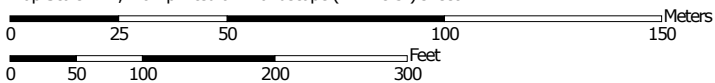
Static Water Depth (ft)



Hydrologic Soil Group—Sedgwick County, Kansas



Map Scale: 1:1,740 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84




MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines


 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points






 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available


Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sedgwick County, Kansas
 Survey Area Data: Version 9, Dec 10, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 18, 2010—Sep 27, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Sedgwick County, Kansas (KS173)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
5943	Saltcreek and Naron fine sandy loams, 0 to 1 percent slopes	C	1.2	18.2%
6224	Canadian fine sandy loam, rarely flooded	B	5.6	81.8%
Totals for Area of Interest			6.8	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

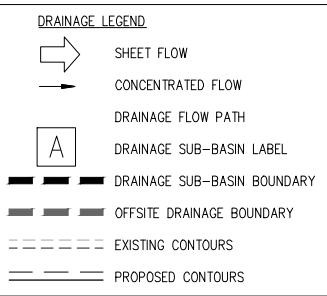
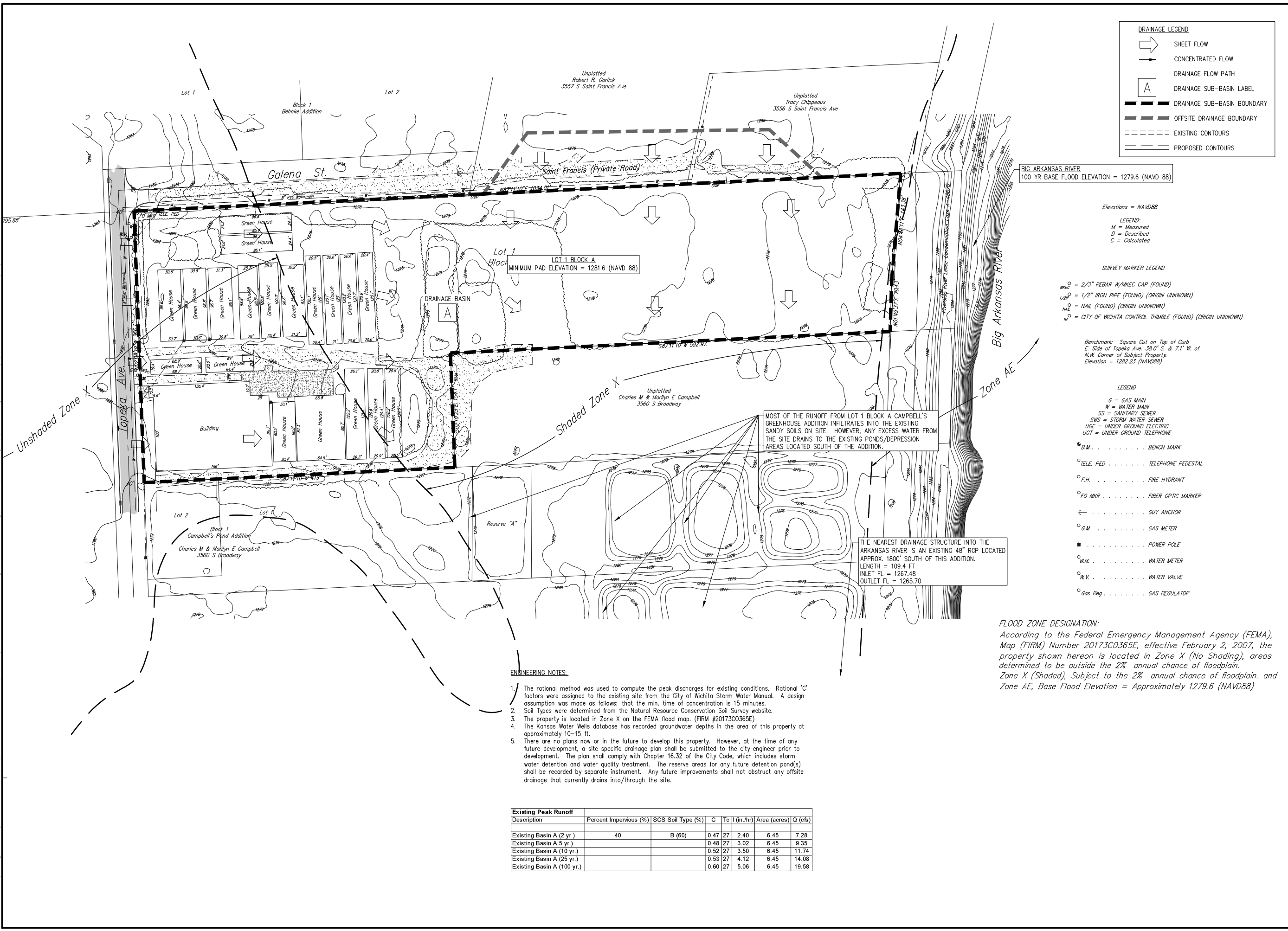
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Mr. Scott Lindebak, P.E. (Con't)
Campbell's Greenhouse Addition
October 9th, 2014

DRAINAGE PLAN MAP

FILE LOCATION: S:\Drawing Files\Project Lum 01-04-11\Campbell's Greenhouse Addition\DWG\Campbell's Greenhouse - DP.dwg TAB NAME: Existing and Developed Drainage Map USER: eng2. SAVED: 10/10/2014 4:59 PM PLOTTED: 10/10/2014 8:32 AM



BIG ARKANSAS RIVER
100 YR BASE FLOOD ELEVATION = 1279.6 (NAVD88)

Elevations = NAVD88

LEGEND:
M = Measured
D = Described
C = Calculated

SURVEY MARKER LEGEND

- M/E/C = 2/3" REBAR W/M/E/C CAP (FOUND)
- 1/2" = 1/2" IRON PIPE (FOUND) (ORIGIN UNKNOWN)
- NAIL = NAIL (FOUND) (ORIGIN UNKNOWN)
- HT = CITY OF WICHITA CONTROL THIMBLE (FOUND) (ORIGIN UNKNOWN)

Benchmark: Square Cut on Top of Curb
E Side of Topoka Ave. 38.0' S. & 7.1' W. of
N.W. Corner of Subject Property.
Elevation = 1282.25 (NAVD88)

LEGEND

- G = GAS MAIN
- W = WATER MAIN
- SS = SANITARY SEWER
- SWS = STORM WATER SEWER
- UGE = UNDER GROUND ELECTRIC
- UGT = UNDER GROUND TELEPHONE

- B.M. BENCH MARK
- TELE. PED TELEPHONE PEDESTAL
- F.H. FIRE HYDRANT
- FO MKR FIBER OPTIC MARKER
- GUY ANCHOR GUY ANCHOR
- G.M. GAS METER
- POWER POLE POWER POLE
- W.M. WATER METER
- W.V. WATER VALVE
- Gas Reg. GAS REGULATOR

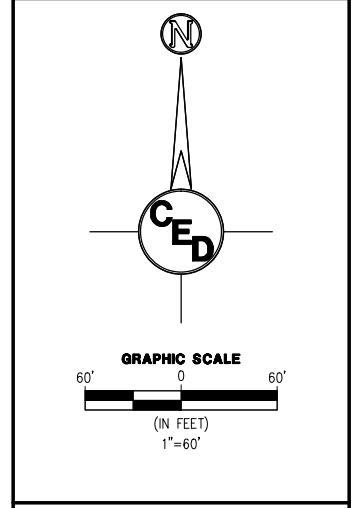
MOST OF THE RUNOFF FROM LOT 1 BLOCK A CAMPBELL'S GREENHOUSE ADDITION INFILTRATES INTO THE EXISTING SANDY SOILS ON SITE. HOWEVER, ANY EXCESS WATER FROM THE SITE DRAINS TO THE EXISTING PONDS/DEPRESSION AREAS LOCATED SOUTH OF THE ADDITION.

THE NEAREST DRAINAGE STRUCTURE INTO THE ARKANSAS RIVER IS AN EXISTING 48" RCP LOCATED APPROX. 1800' SOUTH OF THIS ADDITION.
LENGTH = 109.4 FT
INLET FL = 1267.48
OUTLET FL = 1265.70

- ENGINEERING NOTES:**
- The rational method was used to compute the peak discharges for existing conditions. Rational 'C' factors were assigned to the existing site from the City of Wichita Storm Water Manual. A design assumption was made as follows: that the min. time of concentration is 15 minutes.
 - Soil Types were determined from the Natural Resource Conservation Soil Survey website.
 - The property is located in Zone X on the FEMA flood map. (FIRM #20173CO365E)
 - The Kansas Water Wells database has recorded groundwater depths in the area of this property at approximately 10-15 ft.
 - There are no plans now or in the future to develop this property. However, at the time of any future development, a site specific drainage plan shall be submitted to the city engineer prior to development. The plan shall comply with Chapter 16.32 of the City Code, which includes storm water detention and water quality treatment. The reserve areas for any future detention pond(s) shall be recorded by separate instrument. Any future improvements shall not obstruct any offsite drainage that currently drains into/through the site.

Existing Peak Runoff Description	Percent Impervious (%)	SCS Soil Type (%)	C	Tc I (in./hr)	Area (acres)	Q (cfs)
Existing Basin A (2 yr.)	40	B (60)	0.47	27 2.40	6.45	7.28
Existing Basin A (5 yr.)			0.48	27 3.02	6.45	9.35
Existing Basin A (10 yr.)			0.52	27 3.50	6.45	11.74
Existing Basin A (25 yr.)			0.53	27 4.12	6.45	14.08
Existing Basin A (100 yr.)			0.60	27 5.06	6.45	19.58

REV.	DESCRIPTION	DATE



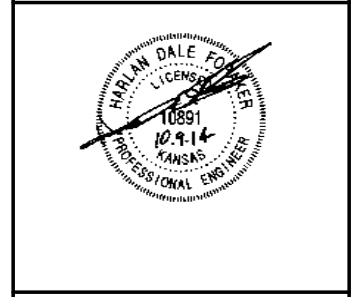
CAMPBELL'S GREENHOUSE ADDITION

SW ¼ OF SECTION 9, T28S, R1E
SEDGWICK COUNTY, KS

CERTIFIED ENGINEERING DESIGN, P.A.
CIVIL ENGINEERING SERVICES



1935 WEST MAPLE STREET
WICHITA, KANSAS 67213
PH.(316)262-8808 FAX.(316)262-1669



PROJECT NO.: 20142194
ISSUE DATE: 10/09/14
CONTACT: L MILLS / H. FORAKER
CHECKED BY:

DRAINAGE PLAN

1 OF 1

Mr. Scott Lindebak, P.E. (Con't)
Campbell's Greenhouse Addition
October 9th, 2014

TIME OF CONCENTRATION CALCULATIONS

Project	Campbell's Greenhouse Add.
Feature	TC Calcs
Analyst	Logan Mills
Version	10/9/2014
Notes	... notes

Sheet	Subbasin	Number of Segments	Sheet Flow (mins)	Shallow Concentrated Flow (mins)	Open Channel Ditch Flow (mins)	Open Channel Pipe Flow (mins)	Open Channel General Flow (mins)	Other (mins)	Total Tc (mins)	Length (feet)	Drop (feet)	Avg. Slope (%)	Avg. Vel. (fps)	Lag (mins)	Lag (hours)	Area (acres)
1	A	2	18.7	7.8	0.0	0.0	0.0	0.0	26.5	421	4	0.95	0.26	15.9	0.265	500
2	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
3	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
4	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
5	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
6	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
7	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
8	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
9	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
10	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
11	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
12	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
13	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
14	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	0.00	0.82	16.4	0.273	500
15	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
16	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
17	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
18	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
19	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
20	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
21	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
22	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
23	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
24	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
25	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500
26	0	6	20.3	2.4	0.1	0.2	0.1	4.2	27.3	1350	47	3.48	0.82	16.4	0.273	500

Mr. Scott Lindebak, P.E. (Con't)
Campbell's Greenhouse Addition
October 9th, 2014

MISCELLANEOUS DRAINAGE INFORMATION

Intensity values are based on regression analysis of data obtained from NOAA Atlas 14, Volume 8); Return Periods 1-yr through 10-yr based on Point Precipitation Frequency Estimates (Partial Duration Series); Return Periods 25-yr through 1000-yr based on Point Precipitation Frequency Estimates (Annual Maximum Series). Data values used in the regression analysis were obtained from the NOAA Precipitation Frequency Data Server for Wichita-Mid Continent weather station location.

Table 1 City of Wichita and Sedgwick County, KS Rainfall Intensity Table (Duration 5 min – 120 min)

DURATION in hours	DURATION in	Return Period									
		1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	1000-yr
0.0833	5	5.07	5.43	6.79	7.82	9.14	10.16	11.17	12.16	13.45	14.44
0.1000	6	4.75	5.08	6.35	7.30	8.53	9.46	10.38	11.28	12.45	13.32
0.1167	7	4.47	4.78	5.97	6.87	8.02	8.88	9.73	10.56	11.64	12.44
0.1333	8	4.22	4.52	5.65	6.49	7.58	8.39	9.18	9.96	10.97	11.71
0.1500	9	4.01	4.29	5.36	6.16	7.19	7.96	8.71	9.44	10.40	11.10
0.1667	10	3.82	4.09	5.11	5.87	6.86	7.59	8.30	9.00	9.91	10.57
0.1833	11	3.65	3.90	4.88	5.62	6.56	7.26	7.94	8.61	9.48	10.12
0.2000	12	3.50	3.74	4.68	5.38	6.29	6.96	7.62	8.26	9.10	9.72
0.2167	13	3.36	3.59	4.50	5.18	6.05	6.70	7.33	7.95	8.76	9.36
0.2333	14	3.23	3.46	4.33	4.99	5.83	6.46	7.07	7.67	8.46	9.04
0.2500	15	3.12	3.34	4.18	4.81	5.63	6.24	6.83	7.42	8.19	8.75
0.2667	16	3.01	3.22	4.04	4.66	5.45	6.04	6.62	7.19	7.94	8.49
0.2833	17	2.92	3.12	3.92	4.51	5.28	5.86	6.42	6.98	7.71	8.25
0.3000	18	2.83	3.02	3.80	4.37	5.13	5.69	6.24	6.78	7.50	8.03
0.3167	19	2.74	2.93	3.69	4.25	4.99	5.53	6.07	6.60	7.31	7.83
0.3333	20	2.67	2.85	3.58	4.13	4.85	5.38	5.91	6.43	7.13	7.64
0.3500	21	2.59	2.77	3.49	4.02	4.73	5.25	5.76	6.28	6.96	7.46
0.3667	22	2.52	2.70	3.40	3.92	4.61	5.12	5.63	6.13	6.80	7.30
0.3833	23	2.46	2.63	3.32	3.83	4.50	5.00	5.50	6.00	6.65	7.14
0.4000	24	2.40	2.57	3.24	3.74	4.40	4.89	5.38	5.87	6.52	7.00
0.4167	25	2.34	2.51	3.16	3.65	4.30	4.78	5.27	5.75	6.39	6.87
0.4333	26	2.29	2.45	3.09	3.57	4.21	4.68	5.16	5.63	6.26	6.74
0.4500	27	2.24	2.40	3.02	3.50	4.12	4.59	5.06	5.53	6.15	6.62
0.4667	28	2.19	2.34	2.96	3.42	4.04	4.50	4.96	5.42	6.04	6.50
0.4833	29	2.15	2.30	2.90	3.35	3.96	4.42	4.87	5.33	5.94	6.39
0.5000	30	2.10	2.25	2.84	3.29	3.89	4.33	4.78	5.24	5.84	6.29
0.5167	31	2.06	2.20	2.79	3.23	3.82	4.26	4.70	5.15	5.74	6.19
0.5333	32	2.02	2.16	2.74	3.17	3.75	4.18	4.62	5.06	5.65	6.10
0.5500	33	1.98	2.12	2.69	3.11	3.68	4.11	4.55	4.98	5.57	6.01
0.5667	34	1.95	2.08	2.64	3.06	3.62	4.05	4.48	4.91	5.48	5.92
0.5833	35	1.91	2.05	2.59	3.01	3.56	3.98	4.41	4.83	5.40	5.84
0.6000	36	1.88	2.01	2.55	2.96	3.50	3.92	4.34	4.76	5.33	5.76
0.6167	37	1.85	1.98	2.51	2.91	3.45	3.86	4.28	4.70	5.26	5.69
0.6333	38	1.82	1.94	2.47	2.86	3.40	3.80	4.22	4.63	5.19	5.61
0.6500	39	1.79	1.91	2.43	2.82	3.35	3.75	4.16	4.57	5.12	5.54
0.6667	40	1.76	1.88	2.39	2.78	3.30	3.70	4.10	4.51	5.06	5.48
0.6833	41	1.73	1.85	2.36	2.74	3.25	3.65	4.05	4.45	4.99	5.41
0.7000	42	1.71	1.83	2.32	2.70	3.21	3.60	3.99	4.39	4.93	5.35
0.7167	43	1.68	1.80	2.29	2.66	3.16	3.55	3.94	4.34	4.88	5.29
0.7333	44	1.66	1.77	2.26	2.62	3.12	3.51	3.89	4.29	4.82	5.23
0.7500	45	1.63	1.75	2.22	2.59	3.08	3.46	3.85	4.24	4.76	5.17
0.7667	46	1.61	1.72	2.19	2.55	3.04	3.42	3.80	4.19	4.71	5.12
0.7833	47	1.59	1.70	2.17	2.52	3.00	3.38	3.76	4.14	4.66	5.07
0.8000	48	1.57	1.68	2.14	2.49	2.97	3.34	3.71	4.10	4.61	5.01
0.8167	49	1.55	1.66	2.11	2.46	2.93	3.30	3.67	4.05	4.56	4.96
0.8333	50	1.53	1.63	2.08	2.43	2.90	3.26	3.63	4.01	4.52	4.92
0.8500	51	1.51	1.61	2.06	2.40	2.86	3.22	3.59	3.97	4.47	4.87
0.8667	52	1.49	1.59	2.03	2.37	2.83	3.19	3.56	3.93	4.43	4.82
0.8833	53	1.47	1.57	2.01	2.34	2.80	3.16	3.52	3.89	4.39	4.78
0.9000	54	1.45	1.56	1.99	2.32	2.77	3.12	3.48	3.85	4.35	4.74
0.9167	55	1.43	1.54	1.96	2.29	2.74	3.09	3.45	3.81	4.31	4.69
0.9333	56	1.42	1.52	1.94	2.27	2.71	3.06	3.41	3.78	4.27	4.65
0.9500	57	1.40	1.50	1.92	2.24	2.68	3.03	3.38	3.74	4.23	4.61
0.9667	58	1.39	1.49	1.90	2.22	2.65	3.00	3.35	3.71	4.19	4.57
0.9833	59	1.37	1.47	1.88	2.19	2.63	2.97	3.32	3.67	4.16	4.54

Table C-1 Rational C Values

Land Use or Surface Characteristics	Percent Impervious	Frequency			
		2	5	10	100
<u>Business</u>					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
<u>Residential 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>Residential 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>Residential 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>Residential 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>Residential 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>Residential 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
<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

Appendix C

Land Use or Surface Characteristics	Percent Impervious	Frequency			
		2	5	10	100
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
<u>Industrial</u>					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
<u>Playgrounds</u>					
	15	0.33	0.35	0.42	0.55
<u>Schools</u>					
	40	0.49	0.51	0.56	0.66
<u>Railroad Yard Areas</u>					
	30	0.43	0.45	0.50	0.62
<u>Undeveloped Urban Areas</u>					
Offsite Flow Analysis (when land use not defined)	45	0.52	0.54	0.59	0.68
<u>Streets</u>					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
<u>Drive, Parking Lots and Walks:</u>					
	96	0.87	0.87	0.88	0.89
<u>Roofs</u>					
	90	0.80	0.85	0.90	0.93
<u>Urban Lawn Areas (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>Urban Lawn Areas (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>Urban Lawn Areas (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>Urban Lawn Areas (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