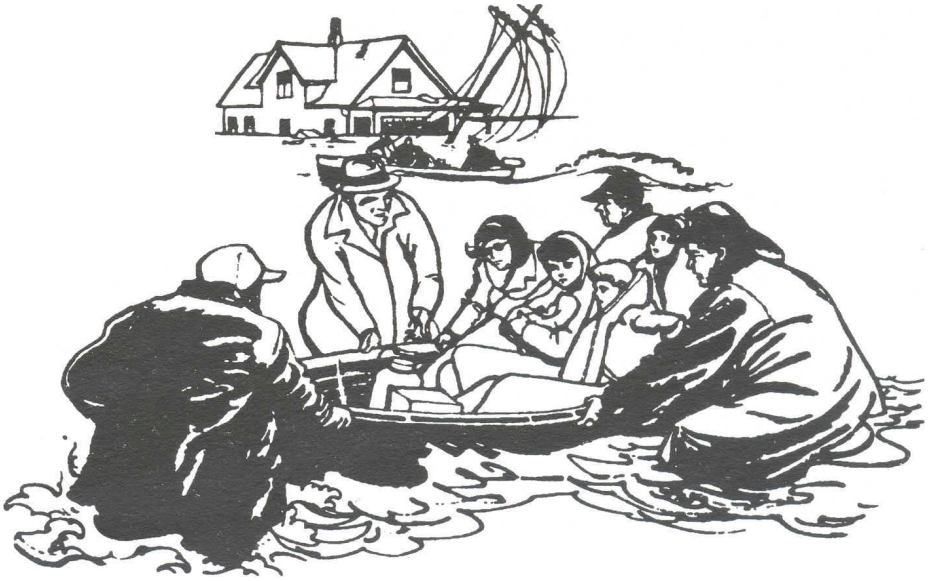
FLOOD INSURANCE STUDY



BARTON COUNTY, KANSAS
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
Albert, City of	200017
Barton County Unincorporated Area	200016
Claflin, City of	200481
Ellinwood, City of	200018
* Galatia, City of	200102
Great Bend, City of	200019
Hoisington, City of	200020
* Olmitz, City of	200013
Pawnee Rock, City of	200021
* Susank, City of	200113

*Non Floodprone Area

Barton County

September 2, 2009

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
20009CVOOOA

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A 1 through A30 B	AE
B	X
C	X

Part or all of this Flood Insurance Study may be revised and republished at any time. In addition, part of this Flood Insurance Study may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the Flood Insurance Study. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current Flood Insurance Study components.

TABLE OF CONTENTS

		Page
1.0	**INTRODUCTION**	1
1.1	Purpose of Study	1
1.2	Authority and Acknowledgments	1
1.3	Coordination	2
2.0	**AREA STUDIED**	2
2.1	Scope of Study	2
2.2	Community Description	2
2.3	Principal Flood Problems	3
2.4	Flood Protection Measures	4
3.0	**ENGINEERING METHODS**	5
3.1	Hydrologic Analyses	6
3.2	Hydraulic Analyses	7
3.3	Vertical Datum	8
4.0	**FLOODPLAIN MANAGEMENT APPLICATIONS**	8
4.1	Flood Boundaries	9
4.2	Floodways	9
5.0	**INSURANCE APPLICATION**	14
6.0	**FLOOD INSURANCE RATE MAP**	15
7.0	**OTHER STUDIES**	15
8.0	**LOCATION OF DATA**	15
9.0	**BIBLIOGRAPHY AND REFERENCES**	17

TABLE OF CONTENTS
(Continued)

FIGURES

Figure 1 – Floodway Schematic 14

TABLES

Table 1 – Summery of Discharges 6
Table 2 – Manning's "n" Roughness Coefficients 7
Table 3 – Floodway Date 10
Table 4 – Community Map History 15

EXHIBITS

Exhibit 1 – Flood Profiles

Arkansas River 01P - 04P
Shop Creek 05P
Shop Creek Tributary 06P
Wet Walnut Creek 07P
Wet Walnut Creek Right Back Overflow 08P

FLOOD INSURANCE STUDY
BARTON COUNTY, KANSAS AND INCORPORATED AREAS

1.0

INTRODUCTION

1.1

Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Barton County, Kansas, including the Cities of Albert, Claflin, Ellinwood, Great Bend, Galatia, Hoisington, Olmitz, Pawnee Rock, Susank and the unincorporated areas of Barton County, Kansas (referred to collectively herein as Barton County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the Cities of Olmitz, Galatia, and Susank are non-floodprone.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence.

The Digital Flood Insurance Rate Map (DFIRM) and FIS Report for this countywide study have been produced in digital format. Flood hazard information was converted to meet the FEMA DFIRM database specifications and Geographic Information System (GIS) format requirements. The flood hazard information was created and is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community.

1.2

Authority and Acknowledgments

The sources of authority for this FIS report are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the Cities of Albert, Great Bend and Barton County were performed by the U.S. *Army Corps* of Engineers (USACE), Tulsa District, for the Federal Emergency Management Agency (FEMA), under Interagency Agreement No. EMWE-0941, Project Order No.8. This study was completed in March of 1984.

The hydrologic and hydraulic analyses for the City of Pawnee Rock were performed by the USACE, Tulsa District, for FEMA, under Interagency Agreement No. EMW -E-0941, Project Order No.8. This study was completed in November of 1984.

The hydrologic and hydraulic analyses for the City of Hoisington were performed by the USACE, Tulsa District, for FEMA, under Interagency Agreement No. EMW -E-0941, Project Order NO.8. This study was completed in June of 1985.

The hydrologic and hydraulic analyses for the Ellinwood were performed by Howard, Needles, Tammen and Bergen doff for the Federal Insurance Administration (PIA), under contract H-40 11. This study was completed in May 1977.

The hydrologic and hydraulic analyses for this Study were performed by R&S Digital Services, Inc, for FEMA, under Interagency Agreement No. EMK-2004-CA-4019.

The authority and acknowledgments for the City of Claflin are not available because no PIS report was ever published for this community.

1.3

Coordination

The initial Consultation Coordination Officer (CCO) meeting was held on May 10, 1982 at the Barton County courthouse, and attended by representatives of FEMA, the study contractor, and county officials. Streams requiring detailed study were identified at this meeting. The Kansas Water Office was contacted for information related to the study. They provided high-water mark data for the county. The U.S. Geological Survey (USGS) provided peak-discharge data that were gathered after the June 15, 1981, flood.

The results of the study were reviewed at the final CCO meeting held on September 15,1987, and attended by representatives of FEMA, the study contractor and the local community. All problems raised at that meeting have been addressed in the previous study.

For this countywide FIS, a CCO meeting was held in June 2004. A Final CCO meeting was held on August 11, 2008. These meetings were attended by representatives of the Barton County, the Cities of Great Bend and Hoisington, FEMA, and the Kansas Department of Agriculture.

2.0 **AREA STUDIED**

2.1 Scope of Study

This FIS report covers the geographic area of Barton County, Kansas, including the incorporated communities listed in Section 1.1.

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and the local communities.

2.2 Community Description

Barton County is located in central Kansas. It is bordered by Russell County on the north, Ellsworth and Rice Counties on the east, Stafford County on the south, Pawnee County on the southwest and Rush County on the west. Barton County is served by U.S. Highways 56, and 281, State Highways 4,96, and 156, and the Atchison, Topeka and Santa Fe Railway. The 2005 population of Barton County was reported to be 28,105.

Stands of elm, mulberry, box elder, salt cedar, cottonwood, and willow trees occur in a narrow belt along the stream valleys. The remaining cover consists of range grasses and cultivated crops, principally wheat, soybeans, grain sorghum, com, and alfalfa. Outcrops in the study area consist of limestone, shales, and sandstones. Soils vary from residual materials in the upland areas to alluvial types in the floodplains and river terraces.

The climate for Barton County is classified as sub-humid continental. Maximum daily temperatures for July average 96 degrees Fahrenheit (°F) and the minimum temperatures during the same month average 68°F. The maximum temperature for January averages 43°F and the minimum temperature for the same month averages 19°F. The relative humidity is generally less than 50 percent during the mid-afternoon on summer days.

The average annual precipitation for Barton County is approximately 23 inches. Normally, 75 percent of the annual precipitation falls during the 6-month period between April and September. Thunderstorms can be expected 50 to 60 days each year and a few are accompanied by high winds and hail. Droughts are often severe and, occasionally, there can be several successive years that are drier than normal.

2.3 Principal Flooding Problems

Most of the flood-producing storms in Barton County occur between May and September as a result of prolonged or successive thunderstorms that produce heavy rainfall. The flood hazard in Barton County is increased because the streams are very crooked and have brush-lined channels and the overbanks are generally lower than the channel banks. For those two reasons, channel capacity is reduced and overbank flooding is increased.

The Barton County area around the City of Great Bend receives flooding from three major sources: the Arkansas River, Wet Walnut Creek, and Dry Walnut Creek. The first documented flood on the Arkansas River at Great Bend was on July 23, 1895. That flood inundated a large area from south of the Arkansas River north to Main Street beyond the Atchison, Topeka and Santa Fe Railway. Since September 1940, a water-stage recording gage has been in operation on the Arkansas River at the U. S. Highway 281 Bridge at Great Bend. Fragmented stage data are available at the same site from 1908 to 1940. Some flows were estimated based on stage elevations. Other floods on the Arkansas River, which range from a 6% annual chance to a 20% annual chance flood occurred on May 30, 1935, July 30, 1958, and four times from May through July 1951.

The largest flood of record on the Arkansas River at Great Bend occurred on June 23, 1965. At that time, the width of the flooded area exceeded two miles. Because of an early warning and a successful flood fight, urban flood damages at Great Bend were minimized. That flood, which had a recorded flow of27,800 cubic feet per second (cfs), had approximately a 2.5% annual chance of flooding. The City of Ellinwood was also inundated by that flood.

The largest flood of record in Barton County near the City of Hoisington was on June 22, 1981, when 7.37 inches of rain fell in just six hours. Wet Walnut Creek has also inundated Barton County areas near the City of Albert, Kansas; flooding occurred there in 1927, 1950, 1959, and 1981. The flood of record occurred during August 11 and 12, 1927, when heavy rains caused Wet Walnut Creek to flood the Albert area. Precipitation gages at Beaver (an
unincorporated community in Barton County) and Great Rend recorded 4.6 and 6.3 inches of rain, respectively, from that storm. According to information provided by local residents and high-water marks, the August 1927 flood reached an elevation of 1 ,920 feet North American Vertical Datum 1988 (NA VD88) at Albert.

The maximum recorded flow since the Albert gage was installed in 1958, occurred in September 1959. Wet Walnut Creek flooded the Albert area because of locally heavy rainfall. Precipitation gages at the Cities of Bison and Ness City, Kansas, recorded 8.36 and 8.2 inches of rain, respectively. Wet Walnut Creek reached a peak flow of 12,700 cfs at the Albert gage.

The latest flooding in the Albert area occurred in June of 1981. That flood had a peak flow of only 1,550 cfs at the Albert gage; however, agricultural lands sustained extensive damage. Flooding below Albert was greatly increased due to heavy rainfall occurring between Albert and Great Bend.

The second largest flood on the Arkansas River occurred on May 1, 1942. That flood had a 3.3% annual chance of flooding and had a recorded flow of 20,200 cfs.

The third largest flood, which occurred on June 10, 1921, inundated most of Great Bend south of 12th Street. The southeast part of Great Bend south of the railroad tracks was flooded to a depth of four to six feet. That flood had a 5% annual chance of flooding and had an estimated flow of 19,600 cfs at Great Bend.

Historical records show several floods in the Wet Walnut and Dry Walnut Creeks near Great Bend. The first flood of record for Wet Walnut Creek occurred in August 1927. Apparently, local runoff caused by intense rainfall caused the August flood. The precipitation station at Bison recorded 11.94 inches of rain for August, 8.05 inches of which was recorded in a 24hour period on the 13th. Great Bend recorded 6.3 7 inches of rain at its rain gage on the 12th and 13th of August. During the flood, the lower reaches of Wet Walnut Creek were sometimes 3 miles wide. High water marks show that this flood was larger than the September 1959 flood recorded at Albert.

The maximum flood of record on the Wet Walnut Creek occurred in September 1959. That flood resulted from an II-inch rainfall that caused the flow of Wet Walnut Creek to peak at 12,700 cfs at Albert. Because of the intense rainfall, Wet Walnut Creek overflowed its banks from Ness City to its mouth. Because Great Bend received a 3-day advance warning, preventive flood measures were initiated to stop flooding of the city. Flooding did not occur within the city; however, numerous homes and businesses north of the city were flooded. The peak discharge of the September 1959 flood at U. S. Highway 281 in Great Bend was approximately 9,300 cfs; it was about a 5% annual chance of flooding.

In August 1950, general rainstorms in May resulted in a peak flow of 7,500 cfs, 8% annual chance of flooding on W et Walnut Creek near Great Bend. Portions of Barton County and northeast Great Bend were inundated by that flood, causing considerable damage.

The most recent flooding in the Barton County area occurred on June 14, and June 15, 1981. An intense thunderstorm dumped from 10 to 23 inches of rain between Lamed (23 miles southwest of Pawnee Rock) and Great Bend, causing local streams to overflow their banks. Major flooding occurred in the areas of Great Bend, Pawnee Rock, and Hoisington.

Records indicate that Hoisington has been flooded several times. The majority of floods occurred in the Shop Creek watershed.

2.4 Flood Protection Measures

Local interests have provided some protection to Barton County, near Great Bend, against floods on the Arkansas River by constructing low levees and improving the channel.

These levees protect against floods with a 10% annual chance of flooding. Agricultural levees are also located along portions of the Arkansas River; however, they would be overtopped by the 1% annual chance flood event.

This study incorporates the USACE, Tulsa District re-study dated October 16, 1996, of a restudy of Wet Walnut Creek, Dry Walnut Creek, and the Arkansas River to reflect the construction of the Walnut Creek Diversion Channel (WCDC) and levees along the Arkansas River, in the vicinity of the City of Great Bend, Kansas.

"The WCDC project consisted of a channel and levee system designed to intercept the discharge of Wet Walnut and Dry Walnut Creeks, northwest of Great Bend, and divert the discharge to the Arkansas River, southwest of Great Bend. The project also included levees along the Arkansas River from upstream of the confluence with Wet Walnut Creek (approximately River Mile 868.1), to upstream of the airport, west of Great Bend (approximately River Mile 881). The project is designed to provide protection for Great Bend against the .2% Annual Chance of Flooding event. The WCDC is designed to divert flows greater than 2,000 cfs on the Wet Walnut Creek, and all of the Dry Walnut Creek flows to the Arkansas River. Flows up to 2,000 cfs will continue to pass down the natural channel of Wet Walnut Creek.

The HEC-I computer program was used to determine the revised discharges. The revised floodplain boundaries and base (1 % Annual Chance of Flooding event) flood elevations (BFE) were developed utilizing the HEC-2 step-backwater computer program.

The cross sections for the Arkansas River were taken from topographic maps with a 2-foot contour interval. Manning's roughness coefficients remained the same for this revision, with the exception of the "n" values for the Arkansas River overbank areas within the levee, which were reduced from a range of 0.065-0.075 to a value of 0.06. Starting water-surface elevations were obtained from the previous Flood Insurance Study.

The Natural Resources Conservation Service (NRCS) has a Walnut Creek Watershed Work Plan for watershed protection and flood prevention. The work plan has 49 flood-retarding structures and other watershed improvements that will decrease runoff from future storms. The Work Plan is scheduled for completion over a period of several years, and is presently on going, contingent on availability of Federal funds. Portions of the Work Plan have been completed and, as additional projects are completed, the magnitude of future floods from the Walnut Creek watershed will decrease.

The Natural Resources Conservation Service (NRCS) has an ongoing project of four watershed projects planned on Wet Walnut Creek near Albert. The four projects consist of a system of 48 small structures. For this study, only those structures in place in November 1983 were considered completed.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that is expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50, 100-, and 500-year floods, have a 10-,2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceed during any year.

Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the I-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 90 year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Peak discharge-drainage area relationships for the Arkansas River, Wet Walnut Creek, Ash Creek and Shop Creek and Shop Creek Tributary are shown in Table 1, "Summary of Discharges".

Table 1. Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	Drainage Area (square miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
ARKANSAS RIVER					
Just downstream of confluence of Wet Walnut Creek	34,960	17,200	33,800	43,500	69,800
860 miles upstream from mouth	29,860	15,000	29,500	36,900	57,000
WET WALNUT CREEK					
At Albert gauging station	1,495.4	4,740	7,840	9,270	12,800
Flow overtopping State Highway 96	1,495.4	490	1,940	2,570	4,200
Flow overtopping banks upstream of State Highway 96	22.0	1,400	3,600	4,400	6,600
At State Highway 96	22.0	2,100	2,400	2,600	2,900
SHOP CREEK					
At Union Pacific Railroad	5.22	1,540	2,580	2,990	3,900
At 9th Street	4.55	1,380	2,370	2,770	3,500
ASH CREEK TRIBUTARY "A"					
At U.S. Highway 56	2.23	770	1,250	1,450	1,920
ASH CREEK TRIBUTARY "B"					
About 0.3 mile downstream of Bergtal Church Road	1.05	1,100	1,800	2,115	2,800

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data Tables (FDTs) in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Detail-studied streams that were not re-studied as part of this map update may include a "profile base line" on the maps. This "profile base line" provides a link to the flood profiles included in the PIS report. The detail-studied stream centerline may have been digitized or re-delineated as part of this revision. The "profile base lines" for these streams were based on the best available data at the time of their study and are depicted as they were on the previous FIRMs. In some cases where improved topographical data was used to re-delineate floodplain boundaries, the "profile base line" may deviate significantly from the channel centerline or may be outside the Special Flood Hazard Area (SFHA).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed, selected cross-section locations are also shown on the FIRM.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based of field observations of the streams and overbank areas. This information was compared to methodology described by Chow. Manning's 'n' values for the streams studied in detail are shown in Table 2, "Manning's "n" Roughness Coefficients".

Table 2. Manning's "n" Roughness Coefficients

Flooding Source	Roughness Coefficients	
	Channel	Overbanks
Arkansas River	0.030 - 0.045	0.040 - 0.085
Wet Walnut Creek		
at Great Bend	0.050	0.070 - 08085
at Albert	0.080	0.050 - 0.060
Dry Walnut Creek	0.050	0.070 - 0.085
Dry Creek	0.060	0.050
Ash Creek	0.060 - 0.100	0.060 - 0.100
Ash Creek Tributaries		
'A" and "B"	0.060 - 0.100	0.060 - 0.100
Blood Creek	0.025 - 0.070	0.060 - 0.080
Shoo Creek	0.015 - 0.050	0.040 - 0.200

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVO29). With the completion of the NA VO88, many FIS reports and FIRMs are now prepared using NA VO88 as the referenced vertical datum.

To accurately convert flood elevations for all streams in the study area from the current NGVO29 datum to the newer NA VO88 datum, the following procedure was implemented. Vertical datum was adjusted using a method by which each Quad sheet within the Study areas was converted from NGVO29 to NA VO88 at the comers of all sheets. The mean average of the center of each sheet was calculated from the converted comers. An average Conversion factor was then calculated from the average of all the Quad-centers. The average conversion factor for converting NGVO29 to NA VO88 across the entire county was +0.63 feet.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NA VO88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVO29 and NA VO88, visit the National Geodetic Survey website at www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGSI2
National Geodetic Survey SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
(301) 713-4172 (fax)

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access this data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides I-percent-annual-chance floodplain data, which may include a combination of the following: 10,2, I, and 0.2-percent-annual-chance flood elevations; delineations of the I and 0.2-percent-annual-chance floodplains; and a I-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles and Floodway Data tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The O.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and O.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at varying scales with varying contour intervals. The land O.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the I-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards Zones A, AE, AH, AO, and the O.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and O.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations, but cannot be shown due to limitations of the map scale and or lack of detailed topographic data.

F or the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a flood way is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the I-percent-annual-chance floodplain is divided into a floodway and a flood way fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 3, Floodway Data). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and I-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation (WSEL) of the base flood more than I foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure I.

1.PERCENT -ANNUAL-CHANCE FLOODPLAIN

__FLOODWA Y FRINGE

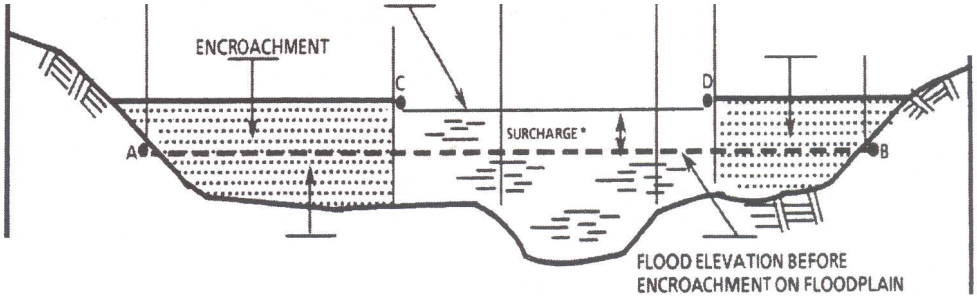
of

FLOODWAY

LOODWAY. FRINGE

STREAM CHANNEL

FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWA Y



ENCROACHMENT

'

AREA OF FLOODPLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND

LINE AS IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
.SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure I. Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the I-percent-annual-chance floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the I-percent-annual-chance floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals withht this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to areas of I-percent-annual-chance shallow flooding (usually areas of pond in g) where average depths are between I foot and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to areas of l-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the O'2-percent-annual-chance floodplain, areas within the O.2-percent-annual-chance floodplain, areas of
l-percent-annual-chance flooding where average depths are less than 1 foot, areas of l-percent-annual chance flooding where the contributing drainage area is less than 1 square mile (sq. mi.), and areas protected from the base flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the l-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1 - and O.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Barton County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 4, "Community Map History".

7.0 OTHER STUDIES

This Flood Insurance Study either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting Federal Insurance and Mitigation Division, FEMA Region VII, 9221 Ward Parkway, Kansas City, Missouri 64114-3337.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population. Number of Inhabitants. Kansas. Washington, D.C., December 1981.

2. U.S. Army Corps of Engineers, Hydrologic Engineering Center, Computer Program 723-X6 L7550 Flood Flow Frequency Analysis. Davis, California, SWD version March 1979.

3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, Climatological Data for Kansas. Asheville, North Carolina.

4. U.S. Department of Commerce, Southwestern Division, The Watershed Runoff Computer Model for Historical and Hypothetical Storm Events. September 1980.

5. U.S. Department of Commerce, Hydrologic Engineering Center, Flood Hydrograph Package. Computer Program 723-X6-L20 I O. HEC - 1 Users Manual. Davis, California, revised September 1981.

6. U.S. Department of Commerce, EM 1110-2-1405 Flood Hydrograph Analyses and Computations. August 1959.

7. U. S. Geological Survey, Technical Report No. II, Magnitude and Frequencv of Floods in Kansas.

8. U.S. Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States. May 1961.

9. Analytical Survey Inc., Photogrammetric Topographic Survey of Ford. Barton and Pawnee Counties. Kansas. Scale I :600, Contour Interval 2 Feet: Colorado Springs, Colorado, ¥arch 1983.

10. Wilson & Company, Engineers & Architects, Great Bend. Kansas. Scale I :600 feet, Contour Interval 2 feet: Salina, Kansas, December 1984.

11. Western Air Maps, Inc., Pawnee. Kansas. Scale 1 :600 feet, Contour Interval 2 feet, Lenexa, Kansas, flown in March 1983.

12. Chow, Yen T. Open-Channel Hydraulics. McGraw-Hill Book Co., Inc., New York, 1959.

13. U.S. Army Corps of Engineers, Hydraulic Engineering Center, Computer Program 723-X6 1202A. HEC-2 Water-Surface Profiles. Davis, California, April 1984.

14. Federal Emergency Management Agency, Flood Insurance Study. City of Ellinwood, Barton County, Kansas June 1982.

15. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map. Barton County, Unincorporated Areas, Kansas, August 1977.

16. Federal Emergency Management Agency, Flood Insurance Study. City of Albert, Barton County, Kansas, January 1986.

17. Federal Emergency Management Agency, Flood Insurance Study. City of Hoisington, Barton County Kansas, February 1986.

18. Federal Emergency Management Agency, Flood Insurance Study, City of Pawnee Rock, Barton County Kansas, July 1986.

19. Federal Emergency Management Agency, Flood Insurance Study, Rice County, Unincorporated Areas, Kansas, July 1987.

20.Federal Emergency Management Agency, Flood Insurance Study, City of Great Bend, Barton County Kansas, October 1996.

21. Federal Emergency Management Agency, Flood Insurance Study, Barton County, Unincorporated Areas, Kansas, August 1988.