FLOOD INSURANCE STUDY



KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

VOLUME 1 OF 3

Community Name	Community Number
KERN COUNTY,	
UNINCORPORATED AREAS	060075
ARVIN, CITY OF	060076
BAKERSFIELD, CITY OF	060077
CALIFORNIA CITY, CITY OF	060440
DELANO, CITY OF	060078
MARICOPA, CITY OF	060079
MCFARLAND, CITY OF	060080
RIDGECREST, CITY OF	060081
SHAFTER, CITY OF	060082
TAFT, CITY OF	065063
TEHACHAPI, CITY OF	060084
WASCO, CITY OF	060085



Kern County

September 26, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06029CV001A

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

Old Zone	New Zone
A1 through A30	AE
B	X (Shaded)
C	X (Unshaded)

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

Initial Countywide FIS Effective Date: September 26, 2008

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Flood Insurance Rate Maps

FLOOD INSURANCE STUDY
KERN COUNTY, CALIFORNIA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Kern County, California, including the Cities of Arvin, Bakersfield, California City, Delano, Maricopa, McFarland, Ridgecrest, Shafter, Taft, Tehachapi, and Wasco and the unincorporated areas of Kern County (referred to collectively herein as Kern County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood hazard 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.

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 and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

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

The FIS was prepared to include the unincorporated areas of, and incorporated areas, within Kern County in a countywide format. Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

The hydrologic and hydraulic analyses for the original study within the unincorporated areas of Kern County were performed by Boyle Engineering Corporation, the study contractor, for the Federal Emergency Management Agency (FEMA), under Contract No. H-4709. This study was completed in March 1984. Additional hydrologic and hydraulic analyses were performed by Ricks Engineering Company, the study contractor, under Contract No. EMW-84-1639 for the Loraine (Upper Caliente Creek), Mojave and Inyokern (Little Dixie Wash) areas and were completed in May 1986.

Revisions within the unincorporated areas of Kern County included the study of Bodfish Creek and East Nicolls Peak alluvial fan. This revision was incorporated in 1989 to update the September 26, 1986, Kern County FIS. The hydrologic and hydraulic analyses were prepared by Gill & Pulver Engineers Inc., the study contractor, for FEMA under Contract No. EMW-89-C-2469. This work was completed in June 1988.

Additional revisions within the unincorporated areas of Kern County were incorporated on March 2, 1994, to provide flood hazard information based on new analyses of flooding on Sand Canyon, Grapevine Canyon, Short Canyon, Indian Wells Canyon, Freeman Gulch and Short Canyon at Kelso Cree he analyses were performed by Aqua Resources, Inc. (ARI), the study contractor, for FEMA under Contract No. EMW-89-C-2844. Portions of the analyses were modified by Michael Baker Jr. Inc., the Technical Evaluation Contractor. In addition, the flood hazard information for Kelso Creek also was revised.

Another revision within the unincorporated areas of Kern County was incorporated on September 6, 1995, to show the modifications made by the Letter of Map Revision (LOMR) issued on June 7, 1994, for the unincorporated areas of Kern County, California. The LOMR reflects more detailed information for the Tropico Hills and West Rosamond alluvial fans. As a result, the Special Flood Hazard Area in the vicinity of the Rosamond Boulevard-Antelope Valley Freeway interchange has increased.

The hydrologic and hydraulic analyses for the City of Bakersfield were performed by Boyle Engineering Corporation, the study contractor, for FEMA, under Contract No. H-4709. This study was completed in March 1981.

The hydraulic analyses for the Kern River between Stockdale Highway and Beardsley Weir within the City of Bakersfield were revised by Dames & Moore under Contract No. C-0970. The analyses were revised to incorporate recent channel improvements and to determine levee-protected areas.

The hydrologic and hydraulic analyses for the City of California City were performed by Boyle Engineering Corporation, the study contractor, for FEMA, under Contract No. H-4709 and EMW-C-0722. This study was completed in January 1983.

The hydrologic and hydraulic analyses for the City of McFarland were performed by Boyle Engineering Corporation, the study contractor, for FEMA, under Contract No. EMW-C-07 22. This study was completed in April 1985.

The hydrologic and hydraulic analyses for the City of Ridgecrest were performed by Boyle Engineering Corporation, the study contractor, for the Federal Insurance Administration, under Contract No. H-4709. This work was completed in January 1980, and covered all significant flooding sources affecting the City of Ridgecrest.

The hydrologic and hydraulic analyses for the City of Shafter were performed by Gill and Pulver Engineers, the study contractors, for FEMA, under Contract No. EMW-87-C-2469. This study was completed in April 1988.

The hydrologic and hydraulic analyses for the City of Taft were performed by Boyle Engineering Corporation, the study contractor, for FEMA, under Contract No. H-4709. This study was completed in March 1984.

The hydrologic and hydraulic analyses for the City of Tehachapi were performed by Boyle Engineering Corporation, the study contractor, for FEMA, under Contract No. 11-4709. This work was completed in January 1980, and covered all significant flooding sources affecting the City of Tehachapi.

The hydrologic and hydraulic analyses for the City of Wasco were performed by Gill and Pulver Engineers Inc., the study contractor, for FEMA, under Contract No. EMW- 87-C-2469. This study was completed in January 1988.

In September 2008, HDR Engineering Inc. completed a countywide DFIRM and FIS for the County of Kern. HDR Engineering Inc. was hired as an IDIQ study contractor for FEMA Region IX under contract number EMF-2003-CO-0045, Task Order 14. The DFIRM process included digitizing floodplain boundaries from the effective paper FIRMs and fitting them to a digital base map, thus converting the existing manually produced FIRMs to digitally produced FIRMs, referred to as DFIRMs. Individual community effective FIS reports also were combined into one report for the entire county.

Planimetric base map information was provided in digital format for FIRM panels. Original FIRM panels were scanned and provided in tif format as a reference for creating the Countywide DFIRM. Public Land Survey System (PLSS) and land ownership data were provided by The California Spatial Information Library (CaSIL). Information on roads was provided by Kern County. Aerial imagery was derived from USDA – Farm Service Agency – Aerial Photography Field Office. Additional imagery for the community areas was provided by Kern County and the City of Bakersfield. Users of this FIRM should be aware that minor adjustments may have been made to specific base map features.

The coordinate system used for the production of this DFIRM is Universal Transverse Mercator (UTM), zone 11N, North American Datum of 1983 (NAD 83), and GRS 1980 spheroid. Corner coordinates shown on the DFIRM are in latitude and longitude. Differences in datum and spheroid used in the production of DFIRMs for adjacent counties may result in slight positional differences in map features and at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS and to identify the streams to be studied by detailed methods. A final CCO meeting is typically held with the representatives of FEMA, the community, and the study contractor to review the results of the study.

Kern County

For the unincorporated areas of Kern County, an initial coordination meeting was held on March 1978. Representatives of FEMA, the unincorporated areas of Kern County, and the study contractor attended the meeting. Flooding sources requiring detailed and approximate analyses were identified at this meeting. Technical coordination meetings were held between representatives of FEMA and the study contractor throughout the duration of the study.

Unpublished information was requested from: the National Weather Service; National Climatic Center; National Technical Information Service; U.S. Army Corps of Engineers

(USACE); U.S. Geological Survey (USGS); National Resources Conservation Services (NRCS), formerly U.S. Soil Conservation Service (SCS); U.S. Forest Service; U.S. Naval Weapons Center at China Lake; Sequoia National Forest; Agricultural Stabilization and Conservation Service; California Department of Water Resources (DWR), Finance, and Transportation; Kern County Water Agency (KCWA), and Kern County Planning Department, Public Works Department, Road Department, Farm and Home Advisor, and Fire Department; Southern Pacific Railroad; Atchison, Topeka & Santa Fe Railroad (AT&SF); Pacific Gas and Electric Company; city governments of Arvin, Bakersfield, California City, Delano, Ridgecrest, Taft , and Tehachapi; Bakersfield Department of Public Works; Lamont Public Utility District; Tehachapi - Cummings County Water District; and private firms, including Great Western Cities, Inc., Mclntire & Quiros, Lusich Patrick Henderson Mueller & Associates, Inc., and Mason, Vancuren and Wachob.

During November and December 1978, a notice explaining the purpose of the FIS for the unincorporated areas of Kern County was published in 11 Kern County newspapers. The notice invited interested persons to furnish relevant facts or technical data about local flood hazards.

The final coordination meeting for the unincorporated areas of Kern County was held on March 13, 1984. Representatives of FEMA, Boyle Engineering Corporation, Kern County Planning and Public Works Departments, and KCWA attended the meeting.. No major problems with this study were identified at that meeting.

An initial coordination meeting for the Loraine, Mojave and Inyokern (Little Dixie Wash) study areas within the unincorporated areas of Kern County was held on April 1984. The meeting was attended by County officials, representatives of FEMA, the California DWR, and the study contractor. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas to be studied by detailed and approximate methods.

A notice explaining the purpose of the Loraine, Mojave and Inyokern (Little Dixie Wash) study was published in the Bakersfield Californian on November 13, 1984. This notice served as an invitation to all interested parties to bring any relevant facts and technical data to the attention of FEMA.

During the course of the Loraine, Mojave and Inyokern (Little Dixie Wash) study, representatives of the Kern County Planning and Development Services Department were contacted on several occasions to gather the most up-to-date information. The NRCS, USACE, USGS, the California DWR, KCWA, and the U.S. Bureau of Reclamation (USBR) also provided information used in this study.

The draft report of the Loraine, Mojave and Inyokern (Little Dixie Wash) study within the unincorporated areas of Kern County was reviewed on April 23, 1986, at a coordination meeting attended by representatives of FEMA, the county, and the study contractor.

An initial CCO meeting was held on December 10, 1986, to discuss the first revisions within the unincorporated areas of Kern County. Representatives of FEMA, Kern County, and the study contractor discussed revisions that included the study of Bodfish Creek and East Nicolls Peak alluvial fan. Available community maps, flood history, and hydrologic data were identified at the meeting.

A meeting with county officials and representatives of the study contractor was held on September 24, 1987, to discuss the study of Bodfish Creek and East Nicolls Peak alluvial fan. This meeting was held as part of a site data collection visit for the first revisions within the unincorporated areas of Kern County,

Two public meetings were held on February 18, 1988, to discuss the scope of the Bodfish Creek and East Nicolls Peak alluvial fan study. Representatives of the County, FEMA, and the study contractor were present.

The results of the Bodfish Creek and East Nicolls Peak alluvial fan study were reviewed at the final CCO meeting held on June 29, 1989. The meeting was attended by representatives of Kern County, California DWR, San Joaquin District, the study contractor, and FEMA. All problems raised at the meeting were addressed.

City of Bakersfield

An initial coordination meeting for the City of Bakersfield was held in March 1978. Representatives of FEMA, the study contractor, and the City of Bakersfield attended the meeting. Flooding sources requiring detailed study were identified during this meeting. Coordination with FEMA was maintained throughout the study to ensure that the study results would meet agency requirements. Technical coordination meetings were held between representatives of the study contractor and FEMA on January 17, 1979, and July 12, 1979.

Unpublished sources of information were requested from the National Weather Service; the National Climatic Center; the National Technical Information Service; the USACE; the USGS; the NRCS; the Forest Service; the California DWR, Finance, and Transportation; the KCWA, Planning Department, Public Works Department, and Fire Department; the Southern Pacific Railroad; the AT & SF; Pacific Gas and Electric Company; the City of Bakersfield Planning Department and Department of Water; Lusich, Patrick, Henderson, Mueller & Associates, Inc.; and Mason, Vancuren & Wachob. Other important contacts made as a result of the coordination effort are described below:

The study contractor for the City of Bakersfield's FIS met with the staff of the KCWA on January 9, 1979, to discuss the availability of topographic maps and profiles on the Kern River. The KCWA staff recommended that the Kern River study limits be extended downstream to include the area south of Stockdale Highway to Enos Lane (upstream of Interstate Highway 5) as approximate study.

The study contractor contacted Mason, Vancuren & Wachob on January 19, 1979, and discussed the results of the Mason, Vancuren & Wachob engineering drainage report on the Hawthorne Ravine-Wilshire Heights area. The principal engineer stated that one of their recommended systems was constructed with a 25-year storm capacity which, he believed, solved most flooding problems in the area. The principal engineer also stated that it was possible that the Kern County Public Works Department subsequently installed a reach on Height Street as well as some other extensions.

Other important contacts made as a result of the coordination effort are described below:

The study contractor contacted the Sacramento District Office of the USACE on January 24, 1979, to request hydraulic data which could be used in a computer backwater analysis of the Kern River.

On February 15, 1979, the KCWA requested FEMA to extend the Kern River study limits to include the area south of Stockdale Highway to Enos Lane (upstream of Interstate Highway 5) as an approximate study area. This area was in the process of being developed.

The study contractor met with representatives of the California DWR on February 26, 1979. Cross sections on the Kern River, peak flow, flooding problems, and possible contacts for information about the Kern River were discussed.

The study contractor requested by letter, dated May 25, 1979, that the USACE revise their Kern River hydrologic data so as not to include expected probability.

The study contractor plotted peak-flow frequency for the Kern River near Bakersfield using USACE data which were not adjusted for expected probability. The resulting curve was sent to the USACE on May 30, 1979, in order to confirm that the data would be suitable for use in hydraulic analyses.

The USACE responded to the study contractor's request for data confirmation with a letter dated June 6, 1979, which pointed out that the study contractor's peak-flow frequency curve did not include a modification accounting for the operation of Lake Isabella. The study contractor enclosed a peak-flow frequency curve consistent with their analysis of the Kern River which accounted for the regulated condition of the river, but did not include an expected probability adjustment.

On July 3, 1979, the study contractor sent the results of their Cottonwood Creek hydrologic analysis to the USGS, USACE, NRCS, the Kern County Department of Public Works, and the KCWA for comments.

The USGS sent comments on July 23, 1979, in regards to the study contractor's Cottonwood Creek results. The USGS said the 1-percent annual chance peak flow should be somewhat higher than 5,600 cubic feet per second (cfs), but admitted their regionalized flood-frequency relations were based on data that do not accurately reflect hydrologic conditions in mountainous areas of Kern County.

Representatives of the study contractor, Kern County Water Agency, and FEMA met in San Francisco on November 13, 1979, to discuss the results of the Kern County FIS. Cottonwood Creek was one of the flooding sources discussed. The study contractor had used storm type IA in the hydrologic analysis to be consistent with surrounding basins, although the NRCS guidelines recommended storm type I. It was decided that the study contractor should use storm type I, which would increase the 1-percent annual chance peak flow from 5,600 cfs to approximately 7,800 cfs.

The study contractor contacted the assistant director of public works for Bakersfield on November 27, 1979. Differences between the results of the study contractor's hydrologic analysis of the Hawthorne Ravine-Wilshire Heights area and those obtained by Mason, Vancuren & Wachob were reviewed. Storm drain capacity, the need to reduce storm drain effective area to account for debris, and the study contractor's plan to reduce peak

flows due to flow carried by the storm drain system were also discussed. Flow rates on the Kern River were mentioned. The assistant director said no improvements that would affect drainage in the city were being planned.

The study contractor sent the Kern River peak flows adopted for the Bakersfield FIS to the City of Bakersfield Public Works Department on December 4, 1979.

On December 17, 1979, the study contractor was contacted by the Kern County Public Works Department which wanted to confirm the study contractor's analysis which had considered recent improvements in the Hawthorne Ravine-Wilshire Heights area. The Public Works Department mentioned that a hydrologic study of part of the Kern River prepared by a Bakersfield engineering firm in 1956 could contain useful information.

An intermediate coordination meeting was held on February 17, 1981, in Bakersfield to discuss preliminary study results. Representatives of FEMA, the study contractor, and the community attended the meeting. No changes to the study were requested at this meeting.

The final coordination meeting was held on March 13, 1984. Representatives of FEMA, the study contractor, Kern County, and the city attended the meeting. All problems raised at the meeting were resolved.

City of California City

An initial coordination meeting was held for the City of California City on March 31, 1978. Flooding sources selected for detailed study were identified at this meeting, which was attended by representatives of FEMA, the study contractor, and the City. Coordination with FEMA was maintained throughout the study to ensure that study results would meet agency requirements. Technical coordination meetings were held between representatives of the study contractor and FEMA on January 17, 1979, and July 12, 1979.

Unpublished information was requested from: National Weather Service; National Climatic Center; National Technical Information Service; USACE; USGS; NRCS; U.S. Forest Service; California DWR and Transportation; KCWA; Kern County Planning, Public Works, and Fire Departments; Southern Pacific Railway; AT & SF; Pacific Gas and Electric Company; Great Western Cities, Inc.; Mclntire & Quiros; and California City.

Application of hydrologic methodology was coordinated with the USACE, Los Angeles District. Results of hydrologic analyses were coordinated with the NRCS, USGS, USACE, California DWR, and KCWA and Public Works Department. Information concerning channel and culvert maintenance and historic flooding problems was obtained from the California City Superintendent of Streets. A California City engineer was contacted concerning drainage system capacity and flowage easements.

A final coordination meeting was held on February 17, 1981, for the City of California City. The results of this study were reviewed by representatives of FEMA, the study contractor, and the City. No problems were raised at the meeting.

City of McFarland

An initial meeting for the City of McFarland was held on July 8, 1981. Flooding sources requiring detailed study were identified at this initial meeting attended by representatives of FEMA, the study contractor, and the City. Coordination with community representatives and FEMA was maintained throughout the study to ensure that study results would meet FEMA requirements. Technical coordination meetings were held between representatives of the study contractor and FEMA on June 2, 1982, and June 28, 1983.

Unpublished and published sources of information were requested from: USACE, USGS; NRCS; USBR; California DWR, Finance, and Transportation; KCWA and Public Works Department; and Southern Pacific Transportation Company and the City of McFarland.

The final community coordination meeting for the City of McFarland was held on October 30, 1985, and attended by representatives of FEMA, the study contractor, and the community. All problems raised at that meeting have been addressed in this study.

City of Ridgecrest

An initial coordination meeting for the City of Ridgecrest was held in March 1978. Flooding sources requiring detailed study were identified at this initial meeting attended by representatives of the Federal Insurance Administration, the study contractor, and the City. Coordination with the Federal Insurance Administration was maintained throughout the study to ensure that study results would meet agency requirements. Technical coordination meetings were held between representatives of the study contractor and the Federal Insurance Administration on January 17, 1979, and July 12, 1979.

Unpublished information was requested from: National Weather Service, National Climatic Center; National Technical Information Service; USACE; USGS; NRCS; U.S. Forest Service; California DWR and Transportation; KCWA; Kern County Planning, Public Works, and Fire Departments; Southern Pacific Railroad; AT&SF; Pacific Gas and Electric Company; City of Ridgecrest; U.S. Naval Weapons Center, China Lake; and interested persons.

An intermediate community meeting for the City of Ridgecrest was held on September 16, 1980, to discuss preliminary study results. Representatives of the Federal Insurance Administration, the study contractor, and the community attended. Concern was expressed by the community about shallow flooding zones in areas where residential development on elevated building sites has occurred. The study contractor reevaluated these areas and incorporated the changes into this study.

The final coordination meeting for the City of Ridgecrest was held on February 19, 1981. The meeting was attended by representatives of the Federal Insurance Administration, the study contractor, and the City. No problems were raised at the meeting that would alter the results of the study.

City of Shafter

An initial CCO meeting for the City of Shafter was held on December 8, 1986. Representatives of FEMA, the study contractor and the City attended. Available community maps, flood history, and hydrologic data were identified at the meeting.

As part of a data-collection site visit, a meeting with city officials of Shafter and representatives of the study contractor was held on September 23, 1987. The Kern County Department of Planning and Development Services, Floodplain Management Division; KCWA; USACE, Sacramento District; U.S. Department of Agriculture; and California Department of Transportation Research Center were contacted for hydrologic data.

The results of the FIS for the City of Shafter were reviewed at the final CCO meeting held on December 6, 1988. The meeting was attended by representatives of the City and FEMA.

City of Taft

An initial coordination meeting for the City of Taft was held in March 1978, and attended by representatives of FEMA, Kern County, and the study contractor (Federal Emergency Management Agency, Flood Insurance Study, September 28, 1990). Flooding sources requiring detailed and approximate analyses were identified at this meeting.

Unpublished information was requested from: the National Weather Service; National Climatic Center; National Technical Information Service; USACE; USGS; NRCS; Agricultural Stabilization and Conservation Service; California. DWR, Finance, and Transportation; KCWA; Kern County Planning Department, Public Works Department, and Road Department; and the city government of Taft.

During November and December 1978, a notice explaining the purpose of the FIS within the City of Taft was published in 11 Kern County newspapers. The notice invited interested persons to furnish relevant facts or technical data about local flood hazards.

The results of the FIS within the City of Taft were reviewed and accepted at a final coordination meeting held on January 15, 1992. The meeting was attended by representatives of FEMA, Kern County Planning and Public Works Departments, KCWA, and the study contractor. No major problems were identified at the meeting.

City of Tehachapi

An initial coordination meeting was held on March 1978, for the City of Tehachapi. Flooding sources requiring detailed study were identified at this meeting attended by representatives of FEMA, the study contractor, and the City. Coordination with FEMA was maintained throughout the study to ensure that study results would meet Federal requirements. Technical coordination meetings were held between representatives of the study contractor and FEMA on January 17, 1979, and July 12, 1979.

Unpublished sources of information were requested from: National Weather Service; National Climatic Center; National Technical Information Service; USACE; USGS; NRCS; U.S. Forest Service; California DWR, Finance, and Transportation; KCWA, Planning Department, Public Works Department, and Fire Department; Southern Pacific Railroad; AT&SF; Pacific Gas and Electric Company; and the City of Tehachapi.

Other important contacts made as a result of the coordination effort are described as follows:

Field reconnaissance was conducted by the study contractor on October 3, 1978.

Information meeting between study contractor and Tehachapi Cummings County Water District held on December 6, 1978. Information meeting between study contractor and KCWA held on December 7, 1978.

On December 19, 1978, NRCS sends water-surface computer output.

Hydrologic analysis was reviewed by NRCS on February 13, 1979, May 29, 1979, June 13, 1979, July 25, 1979, and July 20, 1979, respectively. The study contractor also coordinated hydrology with USACE, USGS, and KCWA.

The hydraulic analysis was coordinated on September 13, 1979 and October 23, 1979, with NRCS.

An intermediate community meeting was held on September 16, 1980, in Tehachapi to discuss preliminary study results. Representatives of FEMA, the study contractor, and the community attended. Revisions to the study were requested by the community and have been incorporated.

A final coordination meeting for the City of Tehachapi was held on July 8, 1981, and was attended by representatives of FEMA, the study contractor, and the City. No problems were raised at the meeting.

City of Wasco

An initial CCO meeting was held on December 9, 1986, with representatives of the City of Wasco, FEMA, and study contractor. Available community maps, flood history, and hydrologic data were identified at the meeting.

As part of a site data collection visit, a meeting with Wasco City officials and representatives of the study contractor was held on September 25, 1987. Hydrologic data were obtained from Kern County Public Works and Kern County Water Agency. Roadway elevations were obtained from the California Department of Transportation.

The results of the FIS for the City of Wasco were reviewed at a final CCO meeting held on August 3, 1988. The meeting was attended by representatives of the City, FEMA, and the study contractor.

The dates of the initial and final CCO meetings held for Kern County and the incorporated communities in its boundaries are shown in Table 1, “Initial and Final CCO Meetings.”

Table 1 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Kern County (Unincorporated Areas)	March , 1978 April , 1984 December 10, 1986	March 13, 1984 N/A June 29, 1989
Arvin, City of	N/A	N/A
Bakersfield, City of	March , 1978	March 13, 1984
California City, City of	March 31, 1978	February 17, 1981
Delano, City of	N/A	N/A
Maricopa, City of	N/A	N/A
McFarland, City of	July 8, 1981	October 30, 1985
Ridgecrest, City of	March , 1978	February 19, 1981
Shafter, City of	December 8, 1986	December 6, 1988
Taft, City of	March , 1978	January 15, 1992
Tehachapi, City of	March , 1978	July 8, 1981
Wasco, City of	December 9, 1986	August 3, 1988

N/A – Not Applicable

For this Countywide FIS, the initial CCO meeting was held on June 29, 2005 for Kern County and its incorporated communities. These meetings were attended by representatives of HDR Engineering, the study contractor, Cities of McFarland and Shafter, Kern County, and FEMA.

For this Countywide FIS, the final CCO meeting was held on January 3, 2008 for Kern County and its incorporated communities. These meetings were attended by representatives of HDR Engineering, the study contractor, Cities of Arvin, Bakersfield, California City, Delano, Maricopa, Ridgecrest, Taft, Tehachapi, Wasco, Kern County, and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Kern County, California, including the incorporated communities listed in Section 1.1. Approximate analyses were used to study those areas having a low potential or minimal flood hazards. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development and construction. The scope and methods of study were proposed to, and agreed upon by, FEMA and Kern County

Kern County

These areas cover the Caliente Creek (Loraine) and Little Dixie Wash (Mojave and Inyokern) located in the eastern part of Kern County.

Detailed methods of analysis were used for Caliente Creek and Little Dixie Wash. Shallow-flooding methods were used where parts of the discharge splits from Little Dixie Wash and flows through the Town of Inyokern. These methods also were used for the Mojave area where the flooding was caused by runoff over alluvial fans originating in the Horned Toad Hills.

Approximate analyses were used in the Sand Canyon area of Caliente Creek and the area south of the Mojave shallow-flooding study area. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards.

In the revisions within the unincorporated areas of Kern County, the Bodfish Creek and the East Nicolls Peak Alluvial Fan were studied. The Bodfish Creek study begins near Harrington Ranch and ends at the confluence of the creek with the Kern River. The entire reach was studied by detailed methods. The East Nicolls Peak study is an analysis of the alluvial fan which begins near East Nicolls Peak and ends at the confluence with Kelso Creek.

Another revision was incorporated on March 2, 1994, to provide flood hazard information based on new analyses of flooding on Sand Canyon, Grapevine Canyon, Short Canyon, Indian Wells Canyon, Freeman Gulch and Short Canyon at Kelso Creek. The analyses were performed by ARI, the study contractor, for FEMA, under Contract No. EMW-89-C-2844. Portions of the analyses were modified by Michael Baker Jr. Inc., the Technical Evaluation Contractor. In addition, the flood hazard information for Kelso Creek was revised.

The alluvial fan flooding on Sand Canyon, Grapevine Canyon, Short Canyon, and Indian Wells Canyon was studied from the respective apexes to the Southern Pacific Railroad. The alluvial fan flooding on Short Canyon at Kelso Creek was studied from the apex to Kelso Creek Road. Freeman Gulch was studied from Little Dixie Wash to Isabella-Walker Pass Road. The flood hazard information for Kelso Creek was revised from approximately 5,000 feet downstream of the confluence with Short Canyon to the confluence with Cane Canyon Creek. 1-percent annual chance flood depths and velocities are shown on the FIRM for Sand Canyon, Grapevine Canyon, Short Canyon, and Indian Wells Canyon.

An additional revision of this study was incorporated on September 6, 1995, to show the modifications made by the LOMR issued on June 7, 1994, for the unincorporated areas of Kern County, California. The LOMR reflects more detailed information for the Tropico Hills and West Rosamond alluvial fans. As a result, the Special Flood Hazard Area in the vicinity of the Rosamond Boulevard-Antelope Valley Freeway interchange has increased.

City of Arvin

Results of the mapping study were not previously summarized in an effective FIS report for the City of Arvin; therefore, no community description is provided.

City of Bakersfield

For the City of Bakersfield the detailed study areas include: the Kern River, upstream of Stockdale Highway; Cottonwood Creek, from its mouth upstream approximately 6,300 feet; and storm runoff in the Hawthorne Ravine-Wilshire Heights area.

The Kern River, downstream of Stockdale Highway, was to be studied by approximate methods; however, that analysis was not complete at the time of this study.

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 City of Bakersfield.

City of California City

In the City of California City, the studies shown are flooding from overflow of Cache Creek and its tributaries, which include Great Circle, Yerba Rusche, and Tierra del Sol Creeks. These streams were selected for detailed analyses. The scope and methods of study were proposed to, and agreed upon by FEMA and the City of California City.

City of Delano

Results of the mapping study were not previously summarized in an effective FIS report for the City of Delano; therefore, no scope of study is provided.

City of Maricopa

Results of the mapping study were not previously summarized in an effective FIS report for the City of Maricopa; therefore, no scope of study is provided.

City of McFarland

In the City of McFarland, the Friant-Kern Canal, State Highway 99, and the Southern Pacific Railroad create north-south barriers to the natural east-to-west water-flow. This obstructed flow causes ponding behind the canal and along the east side of the highway and railroad. Shallow flooding in this area was studied in McFarland using detailed methods.

City of Ridgecrest

In the City of Ridgecrest significant flooding within the study area results from overflow of El Paso Wash, Ridgecrest Wash, and several small tributaries to Satellite and Mirror Lakes, including West China Lake Wash, East China Lake Wash, and College Heights Wash.

Portions of East China Lake Wash and College Heights Wash were studied by approximate methods due to low development potential or minimal flood hazards.

City of Shafter

In the City of Shafter, 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 City of Shafter.

City of Taft

In the City of Taft, Sandy Creek and North Sandy Creek were studied for their entire reaches lying within the city.

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, the Kern County Departments of Planning and Public Works, and KCWA.

City of Tehachapi

Flooding within the City of Tehachapi results from the overflow of Blackburn and Antelope Creeks and was studied by detailed methods. The scope and methods of study were proposed to, and agreed upon by the FEMA and the City of Tehachapi.

City of Wasco

Flooding in the City of Wasco is also included.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles and on the FIRM.

Table 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Antelope Creek	Blackburn Creek
Bodfish Creek	Boron Avenue Creek
Cache Creek	Caliente Creek
Caliente Creek near Loraine	Caliente Creek Tributary 1
Cottonwood Creek	Cuddy Creek
El Paso Wash	Erskine Creek
Indian Creek	Jawbone Canyon Wash
Kern River at Kernville	Kern River – with consideration of Levees
Kern River – without consideration of Levees	Little Dixie Wash
North Sandy Creek	Poso Creek

Table 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Ranger Station Creek	Sandy Creek
South Branch Poso Creek	South Fork Kern River
Tierra Del Sol Creek	Upper Sycamore Creek
Weaver Creek	

All or portions of the flooding sources listed in Table 3, "Flooding Sources Studied by Approximate Methods," were studied by approximate methods. Approximate analyses were used to study only those areas having a low development potential or minimal flood hazards.

Table 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

20 Mule Team Creek	Adobe Canyon Creek	Algelo Ditch	Alphie Canyon Creek
Angel Creek	Antelope Canyon Creek	Arizona Ditch	Arrastre Creek
Arroyo Ancho	Badger Creek	Barker Creek	Bean Canyon Creek
Bear Canyon Creek	Bear Hollow Creek	Bear Trap Canyon Creek	Beck Canyon Creek
Belridge Ditch	Benninger Canyon Creek	Benson Gulch	Berts Canyon Creek
Big Last Chance Canyon Creek	Big Sycamore Canyon Creek	Bird Springs Canyon Creek	Bitter Creek
Bitterwater Creek	Black Bob Canyon Creek	Blackburn Creek	Bodfish Creek
Bonanza Gulch	Bootleg Canyon Creek	Borel Canyon Creek	Boulder Canyon Creek
Boulder Gulch	Bowles Drain	Bradley Canyon Creek	Brite Creek
Bronco Canyon Creek	Browns Canyon Creek	Buena Vista Canyon Creek	Bull Run Creek
Burham Canyon Creek	Burnt Canyon Creek	Butterbread Canyon Creek	Caldwell Creek
Calvert Wash	Cameron Canyon Creek	Canada Del Agua Escondida	Cane Canyon Creek
Cane Creek	Canebrake Creek	Cannell Creek	Cap Canyon Creek
Caparell Creek	Carneros Canyon Creek	Castac Lake	Cat Canyon Creek
Cedar Creek	Chanac Creek	Chance Canyon Creek	Chico Martinez Creek
Chimney Creek	Chollo Canyon South	Cholly Canyon Creek	Cienaga Canyon Creek
Clear Creek	Coal Oil Canyon Creek	Coffee Creek	Cold Springs Canyon Creek
College Heights Wash	Comanche Creek	Connecting Slough	Corn Camp Ditch
Corral Canyon Creek	Cortez Canyon Creek	Cottonwood Canyon Creek	Cow Canyon Creek

Table 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Cow Cove	Cow Heaven Canyon Creek	Coyote Gulch	Crocker Canyon Creek
Crystal Creek	Cub Lake	Cummings Creek	Cyrus Canyon Creek
Dabney Canyon Creek	Dead Ox Creek	Deep Wells Ditch	Deer Canyon Creek
Depot Drain	Devil Canyon Creek	Devils Gulch	Devilwater Creek
Doney Gulch	Dougherty Canyon Creek	Dove Springs Canyon Creek	Duck Pond
Duck Ponds	Dyer Creek	East China Lake Wash	Eighty Foot Ditch
Elk Grove Drain	Emery Ditch	Esperanza Canyon Creek	Falls Creek
Fay Creek	Fiddler Gulch	Five Dog Creek	Flying Dutchman Creek
Four Island Lake	Four Springs Gulch	Fox Canyon Creek	Franciscan Creek
Freeman Canyon Creek	Freeman Gulch	French Gulch	French Ranch Gulch
Frog Creek	Fulton Creek	Gamble Spring Canyon Creek	Garden Ditch
Gibonney Creek	Gold Canyon Creek	Gold Pan Canyon Creek	Goler Gulch
Goose Lake Slough	Gordon Gulch	Granite Canyon Creek	Grapevine Canyon Creek
Grapevine Creek	Great Circle Creek	Grimaud Creek	Grizzly Gulch
Haight Canyon Creek	Hale Mcleod Canyon Creek	Hardcash Gulch	Harper Canyon Creek
Havilah Canyon Creek	Hayes Canyon Creek	Haypress Canyon Creek	Heck Canyon Creek
Hill Canyon Creek	Hillvale Canyon Creek	Hodges Canyon Creek	Hoffman Canyon Creek
Hog Canyon Creek	Hogeye Gulch	Horse Canyon Creek	Horsethief Canyon Creek
Howling Gulch	Indian Wells Canyon Creek	Ingram Canyon Creek	Iron Canyon Creek
Isabella Lake	Jack Canyon Creek	Jenny Lind Canyon Creek	Jerry Slough
Johnson Canyon Creek	Julia Lake	Kelly Canyon Creek	Kelso Creek
King Canyon Creek	Koehn Lake (Dry)	La Rose Creek	Lake Ming
Lake Paulina	Lake Woollomes	Last Chance Canyon Creek	Lavrock Canyon Creek
Little Creek	Little Jawbone Canyon Creek	Little Last Chance Canyon Creek	Little Oak Canyon Creek
Little Poso Creek	Little Sycamore Canyon Creek	Live Oak Canyon Creek	Locked Gate Gulch
Long Canyon Creek	Long Tom Creek	Los Alamos Creek	Los Lobos Creek
Lost Canyon Creek	Lynch Canyon Creek	Manuel Canyon Creek	Marble Spring Canyon Creek
Mcfarland Creek	Media Agua Creek	Menagerie Canyon Creek	Mendiburu Canyon Creek

Table 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Mendibury Creek	Mesquite Canyon Creek	Mike Harney Canyon Creek	Mirasol Drain
Mirror Lake	Mon Canyon Creek	Monotti Creek	Montgomery Canyon Creek
Mormon Canyon Creek	Mormon Gulch	Morris Canyon Creek	Muddy Creek
Myers Canyon Creek	Nellie Dent Creek	New Rim Ditch	Nightingale Gulch
North El Paso Wash	North Fork Cottonwood Creek	North Ridgecrest Wash	Noyer Canyon Creek
Oak Creek	Oil Canyon Creek	Oiler Canyon Creek	Old Rim Ditch
O'neil Creek	Orejano Canyon Creek	Oso Canyon Creek	Packwood Creek
Palomas Drain	Pastoria Creek	Pescado Creek	Peyton Creek
Pine Tree Canyon Creek	Piney Canyon Creek	Pinyon Creek	Placeritas Creek
Pleitito Creek	Pottinger Canyon Creek	Proctor Lake (Dry)	Quail Canyon Creek
Rabbit Gulch	Rag Gulch	Ranch Canyon Creek	Rancheria Creek
Rattlesnake Creek	Red Rock Canyon Creek	Reed Canyon Creek	Rocky Gulch
Rodeo Canyon Creek	Rusk Ditch	Sacatara Creek	Sacramento Gulch
Sage Canyon Creek	Salt Creek	San Emigdio Creek	Sand Canyon Creek
Sand Creek	Sand Gulch	Santiago Creek	Santos Creek
Satellite Lake	Sawmill Canyon Creek	Schoolhouse Drain	Scraper Canyon Creek
Seepage Ponds	Setimo Creek	Seventeen Canyon Creek	Sewage Disposal Ponds
Short Canyon Creek	Smith Canyon Creek	South El Paso Wash	South Fork Cottonwood Creek
South Fork Sand Canyon Creek	South Ridgecrest Wash	Spanish Needle Creek	Spring Canyon Creek
Spring Gulch	Spring Mountain Gulch	Stable Creek	Stag Canyon Creek
Stevenson Creek	Still Canyon Creek	Still Lake	Stratton Canyon Creek
Studhorse Canyon Creek	Sudan Ditch	Sycamore Canyon Creek	Teagle Wash
Tecuya Creek	Tehachapi Creek	Tejon Creek	Tejon Reservoir No. 2
Telephone Canyon Creek	Three Pines Canyon Creek	Tillie Creek	Tollgate Canyon Creek
Tollhouse Canyon Creek	Tom Sawyer Lake	Tremblor Creek	Tunis Creek
Tweedy Creek	Twentyone Canyon Creek	Tylerhorse Canyon Creek	Unnamed Tributary
Walker Basin Creek	Walnut Creek	Water Canyon Creek	Weed Island Ditch
West China Lake Wash	West Fork Creek	West Shore Gulch	White City Canyon Creek

Table 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

White Cow Canyon Creek	Whiterock Creek	Wildcat Creek	Williams Canyon Creek
Willow Gulch	Willow Spring Creek	Willow Springs Valley	Winters Canyon Creek
Witch Creek	Wood Canyon Creek	Woods Canyon Creek	Woolstalf Creek
Yankee Canyon Creek	Yeguas Creek	Yerba Rushe Creek	

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revisions [LOMR], as shown in Table 4, "Letters of Map Change."

Table 4 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
Kern County	Rosamond	07/16/2001	102	00-09-754P
Kern County	Kern River South Levee Upgrade - Phase 2 Return Levee	03/28/2001	LOMR	01-09-298P
Kern County	Inyokern Breakout (Detailed & Approximate Study)	08/28/2002	102	01-09-764P
Kern County	3683 Felsite Avenue	09/18/2002	102	02-09-812P
Kern County	Arvin Farm Labor Center, Caliente Creek	07/17/2003	102	02-09-866P
Kern County	Tentative Tract 6168	10/21/2003	102	03-09-1525P
Kern County	Poso Creek	07/23/2004	102	04-09-0755P
Kern County	Castle & Cooke, Kern River Levee	08/02/2004	102	04-09-0951P
Kern County	Castle & Cooke, Kern River Levee	09/09/2004	102	04-09-1581X
Kern County	Caliente Creek Tributary	04/13/1990	102	04-13-1990
Kern County	Tract 4803-A	06/06/1988	102	06-06-1988

Table 4 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
Kern County	Blackburn Creek	03/15/1995	102	93-09-332P
Kern County	Sears Replenishment Center	11/03/1993	LOMR	93-09-608P
Kern County	Tropical Hills And Rosamond Alluvial Fans	06/07/1994	102	94-09-575P
Kern County	Unnamed Tributary To Sandy Creek	08/10/1994	102	94-09-576P
Kern County	Horned Toad Hills	10/31/1997	102	97-09-1055P
Kern County	Parmount Farms/Delano Site	09/04/1998	LOMR	98-09-890P
Kern County	Kern River South Levee Upgrade	10/05/1999	102	99-09-1120P

2.2 Community Description

Kern County

Kern County lies at the southern end of the San Joaquin Valley, in southern California. The county is bordered on the west by San Luis Obispo and Santa Barbara Counties; on the south by Ventura and Los Angeles Counties; on the east by San Bernardino County and on the north by Kings, Tulare, and Inyo Counties. Kern County covers 8,064 square miles and is California's third largest county. Elevations, in the county, range from 205 feet to 8,775 feet.

The following incorporated communities are included in this study: Cities of Bakersfield, California, Ridgecrest, Shafter, Taft, Tehachapi, and Wasco. The unincorporated areas around Loraine, Mojave, and Inyokern, which are the focus of the restudy, are situated in eastern Kern County.

In 2000, the population of Kern County was 661, 645 (U.S. Census Bureau, State and County Quickfacts for Kern County, 2000). Kern County is served by a number of major highways. Interstate Highway 5 and State Highway 99 are oriented along the north-south axis of the valley. State Highway 58 connects the valley to the Mojave Desert, and State Highway 14 and U.S. Highway 395 run east of the Sierra Nevada range. Maintained county roads exceed 3,362 miles. In addition, there are 10 county airports and 2 railroad lines.

Early settlement in Kern County was spurred by the discovery of gold in 1851. The initial

population was centered in the mountain zone. When Kern County was organized in 1866, the first county seat was Havilah, located approximately 70 miles northeast of Bakersfield. The government center was transferred to Bakersfield in 1873, reflecting the gradual population shift to the valley (Kern County Water Agency, 1368 and 1969).

The county can be divided into three distinct physiographic zones: valley, desert, and mountain., The western one-third of the county, which is the valley portion, is the county's population and agricultural center. Valley crops make Kern County a leading agricultural producer among the nation's counties. The long growing season of 250 to 300 days allows growing a wide range of crops when irrigation is provided. Major agricultural products of the valley include grapes, cotton, cattle, potatoes, almonds, oranges, forage crops, spring and summer vegetables, and rose plants. Annual production of these commodities is valued at more than $15 million each (W. W. Dean, , 1971). Before the advent of agriculture, the valley floor was covered by grassland. It was one of the most productive wildflower areas of the state.

Securing a reliable water supply has been a continuing problem for much of Kern County. Current need in the valley is partly met by supplies from surface-water impoundments, such as Lake Isabella on the Kern River, and from ground water pumping. Additional water must be imported by the Central Valley Project and the California Aqueduct. Because of the need for drainage and irrigation works, farms in the valley traditionally have been, and continue to be, large. Farm size averages 1,752 acres (W. W. Dean, 1971).

The Mojave Desert covers the eastern one-quarter of the county. Major economic activities in the desert depend on the military installations of Edwards Air Force Base and the China Lake Naval Weapons Center, and on mining. One of the world's largest borax deposits is located near Boron. The third zone in the county consists of a ring of foothills and mountains. The Temblor Range, which is part of the Coast Range, borders the western edge of Kern County. The Tehachapi Mountains separate the valley from the Los Angeles basin to the south. The Sierra Nevada range separates the valley from the desert to the east. The western hills contain a major source of petroleum; Kern County produces one-half of California's annual petroleum output. The Tehachapi and Sierra Nevada ranges contain a number of year-round and seasonal resorts and produce commercial timber and minerals.

The vegetation and climate of Kern County vary among its three physiographic zones. Generally, the county is classified as desert or semiarid, with hot, dry summers and mild, humid winters. In most areas, 90 percent of the precipitation occurs from November through April (U.S. Department of the Army, Corps of Engineers, 1951). In the valley, rainfall averages 3 to 7 inches annually.

Because of the topography, the climate of the mountain zone tends to be cooler and wetter than the other zones. The western hills, in the lee of the Coast Range, are semiarid and sparsely vegetated. In contrast, the windward sides of the Tehachapi and Sierra Nevada ranges receive as much as 40 inches of precipitation a year. An average of 30 inches of snow falls at higher elevations. However, most snow cover is intermittent during the winter because of occasional melting (U.S. Department of the Army, Corps of Engineers, 1951). The occurrence of thunderstorms and the potential for intense, local rainfall increase on approaching the Sierra Nevada range. Whereas the western edge of the valley experiences an average of one such storm each year, the number increases to 15 to 20 per year over the mountains. These occur with greatest frequency in the summer

(U.S. Department of the Army, Corps of Engineers, 1951). Four plant communities occur in the mountain zone, depending on site characteristics: oak woodland, coniferous woodland, desert shrub, and grassland (U.S. Department of the Army, 1969).

The desert zone lies in the lee of Tehachapi and Sierra Nevada ranges. Precipitation averages 3 to 6 inches a year, but is extremely variable. Snowfall is infrequent, but may range from 1 to 4 inches when it occurs. Snow and winter rains result from North Pacific cyclonic storms. The remainder of the precipitation comes from intense, local thunderstorms and summer tropical storms. The natural vegetation is sparse and consists primarily of creosote and burroweed. Joshua trees also can occur in some locations.

Many small streams cause flooding problems in the valley when they discharge from steep canyons. These streams are confined and distinct in upland areas, but tend to spread out into a number of poorly defined drainages on the valley floor. Flow is further disrupted by cultivation and urbanization. This type of flooding occurs at Caliente Creek, Poso Creek, Blackwells Corner, and in the vicinity of Taft.

Similar problems occur in the desert area, where ephemeral streams flow across alluvial fans. Drainage channels are poorly defined and can shift from one flood event to the next. Streets, railroads, and other structures divert flows, and may increase flooding problems. Of the flooding sources in the Mojave Desert, only Jawbone Canyon Wash rises in the Sierra Nevada range. The washes affecting the Boron and Ridgecrest areas are defined by local drainage divides.

Another type of flooding occurs in the mountains, where streams flow through alluvial valleys. In these areas flows peak quickly and have high velocities. Mountain flooding sources include Cuddy Creek, Upper Sycamore Creek, Antelope Creek, Blackburn Creek, Caliente Creek, Erskine Creek, and Kelso Creek.

Inyokern is a small unincorporated community that lies in northeastern Kern County and is 10 miles west of the City of Ridgecrest. The area studied near Inyokern includes the Little Dixie Wash. The area studied extends from approximately three miles south of Inyokern to where the wash reaches U.S. Highway 395. A portion of the discharge splits and flows through Inyokern, necessitating a study by shallow-flooding methods for this related area. The proposed land use for areas surrounding Inyokern is mainly light agricultural, with the town itself designated for estate and residential development.

Loraine is a very small unincorporated community in the mountain region of Kern County. The area lies 13 miles north of Tehachapi and 32 miles east of Bakersfield. The study area extends from a point on Caliente Creek near the entrance of Back Canyon, approximately five miles east of the community, to a point just west of the confluence of Indian and Caliente creeks. The study area also includes the approximate study of Sand Canyon and the tributaries of Weaver Creek, Indian Creek, and another tributary that flows along Caliente Creek Road. Proposed land use in the Loraine area consists of small areas of residential and estate zoning surrounded by exclusively agricultural areas.

Mojave is a small unincorporated community situated in the southeastern part of Kern County. It is located approximately 68 miles north of downtown Los Angeles. The area studied for Mojave extends from the Horned Toad Hills northwest of the community, through town to a point approximately 2.5 miles south of Mojave. The urban area of Mojave has a proposed land use of residential areas, with some light manufacturing and commercial areas. The outlying areas are mainly agricultural.

Soils in the Inyokern and Mojave areas are similar in that they both consist of coarse and fine sandy alluvial deposits. In the Loraine area, the soils are mainly typical mountainous upland soil formed from residual material weathered from granite.

Vegetation in the Mojave and Inyokern areas consists of typical desert ground cover. Vegetation in the Loraine area is mainly annual grasses and hardwoods.

City of Arvin

Results of the mapping study were not previously summarized in an effective FIS report for the City of Arvin; therefore no community description is provided.

City of Bakersfield

The City of Bakersfield is located in central Kern County at the southern end of the San Joaquin Valley in south-central California, and it is surrounded by unincorporated areas of Kern County. The city lies 109 miles north of Los Angeles, and is isolated by the Tehachapi and San Emigdio Mountains. State Highways 99, 58, and 178 meet in Bakersfield; rail traffic is carried through the city on the Southern Pacific Railroad and the AT&SF Railway. Bakersfield has grown steadily since it was incorporated on January 11, 1898. The population was 69,515 in 1970, and reached 98,400 by January 1980. In 2000, the City of Bakersfield had a population of 247,057 (U.S. Census Bureau, State and County Quickfacts for City of Bakersfield, 2000).

Originally a ten-acre alfalfa field which served as a rest stop for travelers, Bakersfield currently occupies approximately 76 square miles and supports a multitude of agricultural, industrial, and commercial activities. Oil refining and the distribution of agricultural products are particularly important. Bakersfield is also the Kern County seat of government (D.W. Lantis, California: 1977, Kern County Public Works Dept: 1978).

The climate is classified as subtropical desert, which is characterized by intense summer heat and mild winters (D.W. Lantis, California: 1977). Bakersfield experiences maximum temperatures of 90°F or higher approximately 110 days per year, but temperatures drop below freezing an average of only 16 days per year. Mean monthly temperatures range from 47°F in January to 84°F in July. The average annual precipitation is 6.36 inches, approximately 76 percent of which occurs from November through March (University of California Agricultural Extension Service and the U.S. Weather Service, March 1967). Natural vegetation patterns have been greatly modified by agricultural activities, urbanization, and the extraction of petroleum.

The most significant stream in the area is the Kern River, which originates near Mount Whitney and is regulated by Isabella Dam, which is located approximately 48 miles upstream of Bakersfield. The Kern River flows southwesterly for approximately 29 miles along the northern corporate limits of Bakersfield. The Kern River has an average annual runoff of 700,000 acre-feet (U.S. Department of the Interior, 1969). The Kern River is the chief flooding source in the Bakersfield area. Isabella Dam controls 2,074 square miles of the Kern River basin, but floodwaters can still accumulate from approximately 333 square miles of watershed downstream of the dam. Releases from Isabella Dam and natural runoff flow through a steep canyon for approximately 30 miles downstream of Isabella Reservoir, and then flows southwesterly over the valley floor to Bakersfield. Twenty-one miles downstream of Bakersfield, the Kern River enters Buena Vista

Lakebed or flows to Tulare Lake via the Kern River Flood Canal. Flow can also be diverted to the California Aqueduct via the Kern River-California Aqueduct Interitie, completed in 1977.

On its path to Bakersfield, the Kern River flows by oilfields and appurtenant developments, a State park, and some ranches (U.S. Department of the Army, Corps of Engineers, October 1969). In the city, the river passes near residential development, parks, a golf course, and the campus of California State University, Bakersfield. Most of these areas lie outside of the 1-percent annual chance flood plain.

The Cross Valley Canal is located on the north side of the Kern River and pumps flow in an easterly direction. The canal extends from downstream of Stockdale Highway to just east of Golden State Avenue. Concrete lined, the typical canal section has a bottom width of 14 feet, flow depth of approximately 6.5 feet, freeboard (between canal flow elevations and top of the canal linings) of 1.8 and 2.5 feet, and side slopes of 1.5:1. Levees and protective dikes have been constructed on either side of the canal.

A series of streets running southwest from Bakersfield College to the East Side Canal constitute a flooding source designated as Hawthorne Ravine. A set of streets centered around Wilshire Alley meet Hawthorne Ravine at Irene and Inyo Streets. These streets and adjacent roads constitute a small flooding source which is designated as Wilshire Heights and have been combined with Hawthorne Ravine for detailed study. Natural drainage patterns in this 3 square mile area have been disrupted by urban development.

Cottonwood Creek, a tributary of the Kern River, originates near Breckenridge Mountain in the Sequoia National Forest. The creek has a drainage area of approximately 51 miles, but only flows within city limits for approximately 2 miles before emptying into the Kern River just east of Father Garces Monument in northeast Bakersfield.

Bakersfield lies on the rich and intensively cultivated soil of the San Joaquin Valley at an elevation of approximately 400 feet. The deep alluvial deposits of the valley resulted from erosion of granitic rocks in the Sierra Nevada and sedimentary rocks in the Coast Ranges.

City of California City

The planned community of California City was incorporated on December 10, 1965, and covers an area of 186 square miles, most of which is undeveloped. The city is located in southeastern Kern County, 60 miles southeast of the City of Bakersfield, the county seat, and 120 miles north of the City of Los Angeles. The city is surrounded by unincorporated Kern County land. The nearest major roads are U.S. Highway 395 and State Highways 58 and 14. The community is served by a municipal airport and bus lines.

The population was 1,954 in 1970 and by January 1979, it had increased to 2,620. Economic development is centered around government and military activity, secondary services, and manufacturing (California City Chamber of Commerce, October 1978 and D.W. Lantis, California: Land of Contrast, Dubuque, Iowa: Kendall Hunt, 1977). In 2000, the City of California City had a population of 247,057 (U.S. Census Bureau, State and County Quickfacts for City of California City, 2000).

California City is situated on the western edge of the Mojave Desert at an elevation of 2,450 feet. As part of the Intermontane Plateau system, the western Mojave Desert is an un-tilted fault block bounded on the northwest by the Garlock Fault and on the southwest by the San Andreas Fault. Continued uplift and erosion of the highlands to the west contribute to the alluvial material that covers much of the Mojave Desert area. Landforms are characterized by broad, flat basins dotted with playas, or dry lakes, and by well-eroded uplands. There are no perennial streams in the Mojave Desert, and drainage channels are poorly defined in most of the basins.

The climate is classified as mid-latitude desert. The average annual precipitation is 6.23 inches, approximately 85 percent of which occurs between November and March. Mean monthly temperatures range from 43°F in January to 83°F in July (D.W. Lantis, California: Land of Contrast, Dubuque, Iowa: Kendall Hunt, 1977 and U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1941-70, National Climatic Center, Asheville, North Carolina, February 1978).

Cache Creek, the major flooding source of California City, flows northerly through the city, east of most development. The drainage area of Cache Creek upstream of California City is 163.4 square miles. Tierra del Sol Creek drains 2.7 square miles within the corporate limits. Yerba Rusche Creek and its tributary, Great Circle Creek, drain 5.0 square miles in the western portion of the developed area. Yerba Rusche Creek flows into Cache Creek north of the detailed study area. Development along the flood plain for all four streams studied in detail is entirely residential.

Vegetation is sparse, reflecting the desert climate. The most common species are creosote and burrowed with Joshua-trees occurring on well-drained slopes. Soils are poorly developed because of the lack of moisture and vegetation.

City of Delano

Results of the mapping study were not previously summarized in an effective FIS report for the City of Delano; therefore no community description is provided.

City of Maricopa

Results of the mapping study were not previously summarized in an effective FIS report for the City of Maricopa; therefore no community description is provided.

City of McFarland

McFarland is located in northwest Kern County, in southwest-central California. The city is approximately 22 miles northwest of Bakersfield, and 98 miles southeast of Fresno, near the southern end of the San Joaquin Valley. The population of McFarland was 5,151 in 1980 (U.S. Department of Commerce, Bureau of the Census, March 1982). In 2000, the City of McFarland had a population of 9,618 (U.S. Census Bureau, Profile of General Demographic Characteristics for City of McFarland, 2000). Agriculture around McFarland is extensive, with grapes, nuts, and oranges grown in the unincorporated areas of Kern County that surround the city.

Topography in the McFarland area gently slopes from east to west. There are three barriers oriented in a north-south direction that cause ponding and divert the flow of floodwaters. These barriers are: the Friant-Kern Canal, located 1 mile east of McFarland; State Highway 99, which is the main highway into McFarland; and the Southern Pacific Railroad, which parallels the highway.

Mean annual precipitation in the area is approximately 6.8 inches, with most rainfall occurring from November to April (Ricket and Reaves, Civil Engineers,1959). Generally, the storms last for 6 to 8 hours, but occasional storms of lesser intensity may bring rain to the area for 8 days or more.

City of Ridgecrest

The City of Ridgecrest was incorporated November 29, 1963. The corporate limits encompass 12.5 square miles, approximately 28 percent of which is developed land. Ridgecrest is located in northeastern Kern County, approximately 118 miles west from Bakersfield, the county seat, and 155 miles north of Los Angeles. The city is served by U.S. Highway 395 and State Highway 178. The nearest commercial airfield is at Inyokern, 10 miles to the west. Adjacent to Ridgecrest to the north and east is the community of China Lake and San Bernardino County; elsewhere, the city is bounded by Kern County. The population has increased from fewer than 100 people in 1936 to 15,050 in 1979. This growth is due primarily to the proximity of the Naval Weapons Center at China Lake, established in 1943. In 2000, the City of Ridgecrest had a population of 24,927 (U.S. Census Bureau, Profile of General Demographic Characteristics for City of Ridgecrest, 2000).

The flood plains south and west of the city of Ridgecrest contain many manmade obstructions (embankments), which include the Southern Pacific Railroad, old U.S. Highway 395, and the new U.S. Highway 395. Within the developed areas of the city, the land use is a mixture of open space and residential housing and strip commercial development along Inyokern Road, China Lake Boulevard, and Ridgecrest Boulevard (City of Ridgecrest, Planning Department, General Plan, 1981 - 1995, Draft Copy, 1980). Future development within the city is encouraged to fill in the existing scattered development areas.

Ridgecrest lies at an elevation of approximately 2,300 feet in the Indian Wells Valley at the north edge of the Mojave Desert in south-central California. The valley floor is a dropped block bounded on the west by the Sierra Nevada, and on other sides by low drainage divides. This closed basin is filled with alluvial material from the surrounding uplands. As the ephemeral streams discharge from the foothills, they drop their sediment load, heaviest particles first, forming alluvial fans. Stream courses on the fans are constantly changing, are poorly defined, and have small capacity. On the valley floor, water coalesces and generally flows in sheets, eventually collecting in playas and ephemeral lakes.

Ridgecrest is located at the base of several alluvial fans, and is affected by the ephemeral streams that formed the fans. El Paso Wash rises in the El Paso Mountains to the south-southwest of Ridgecrest, and flows outside the corporate limits along the northwestern edge of the city. Ridgecrest Wash, also rises in the El Paso Mountains and flows into the city from the southwest. Areas in south-southeast Ridgecrest are affected by numerous unnamed washes that empty into Satellite and Mirror Lakes. None of these flooding sources have sustained flow through out the year.

The climate of Indian Wells Valley is classified as mid-latitude desert. The average annual precipitation is approximately 2.98 inches, resulting from general winter storms, summer tropical storms, and local thunderstorms. Although precipitation has been recorded in all months, approximately 60 percent of it occurs in winter, from November through March (U.S. Department of the Navy, Oceanographic Command Detachment, Meteorological Records, 1946 - 1976). Vegetation is sparse, reflecting the desert climate. Common species are creosote (Larrea divaricata) and burrowed (Franseria dumosa). Soils are poorly developed and agriculture is not an important economic activity in the valley.

City of Shafter

The City of Shafter is located in the fertile farm lands of the Southern San Joaquin Valley. Shafter is located about 120 miles north of Los Angeles, 270 miles south of San Francisco, and 18 miles northwest of Bakersfield. The city is situated on the eastern side of the valley floor about 345 feet above sea level (City of Shafter Chamber of Commerce, June 1987). The population of the City of Shafter was 7,525 in January 1987, a 41 percent increase from 5,327 in 1970 (Department of Finance, January 1986 and 1987, May 1987). Population growth from agriculture and some oil expansion has been steady. In 2000, the City of Shafter had a population of 12,736 (U.S. Census Bureau, Profile of General Demographic Characteristics for City of Shafter, 2000).

The incorporated area of the City of Shafter is approximately 1.2 square miles. Of this area, approximately 18 percent is commercial, 15 percent is manufacturing, and 67 percent is residential. There is mixed land use near Shafter Avenue and Lerdo Highway, and strip commerce at locations along Shafter Avenue, Lerdo Highway, and the Central Valley Highway.

The climate in Shafter is typical of the southern San Joaquin Valley, which is relatively hot and arid. Temperatures range from an average low of 45°F in winter to an average high of 82°F in summer. Average annual rainfall is 6.25 inches, and the prevailing wind is from the northwest, averaging 2 to 5 miles per hour (City of Shafter Chamber of Commerce, June 1987). Soil types in the City of Shafter are largely well drained sandy barns.

City of Taft

The City of Taft, with an area of approximately 4 square miles, lies on the arid western edge of Kern County, California. State Highways 33 and 119 meet at Taft, linking the community with Bakersfield, 40 miles to the northeast, and with Los Angeles, 120 miles to the south via Interstate Highway 5. The low, barren Buena Vista Hills rising northeast of Taft separate the city from the vast floor of the San Joaquin Valley, and form the boundary of the shallow Midway Valley in which the city is situated. In 1980, the City of Taft ranked 317th in the state with a population of 5,316 residents (U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, California, 1981). In 2000, the City of Taft had a population of 6,400 (U.S. Census Bureau, Profile of General Demographic Characteristics for City of Taft, 2000).

The City of Taft is one of the world’s most important oil production areas, and has always been dominated by petroleum production, which began in the mid 1800s. Community development came in 1907 with the extension of railroad lines into the area. With the big oil well gushers of 1910, the City of Taft, named for the President of that

era, became a boom town. Many large oil companies acquired interests in the area and provided the base for the economic and social development of the town, including Standard Oil which was headquartered in Taft until the early 1970s.. As the oil fields in the neighboring areas began to dry up, the oil companies turned the surface properties into farmlands. Agriculture increased in the 1960s with the water available from the new California Aqueduct. Taft, however, did not follow the agricultural patterns of its neighbors and continues to rely on the petroleum industry today for its economic base.

The City of Taft lies in the rain shadow of the coastal ranges; therefore, summers are typically hot and dry. The Kern County General Soils Map and the Kern County Climatalogical Report dated 1987 (Kern County Water Agency, 1967) indicate the area to be very arid. Winters are mild and brief, and usually have a few days of frost, but no heavy freezes. Temperatures reaching 105 degrees are common from June through September; however, the average annual temperature is 64 degrees. Rainfall averages 5 inches per year, but ranges from 3 to 10 inches in any given year, with over 90% of the total rainfall occurring between December and April. The months of November through February are characterized by frequent nocturnal fogs.

Greater Taft is situated on gently sloping alluvial deposits in the shallow Midway Valley. The alluvium is dissected by intermittent streams, Sandy Creek, and its tributaries. The tributaries run eastward through Taft toward its natural terminus, the Buena Vista Lake bed. These streams cause flooding problems in the valley when they discharge from steep canyons.

City of Tehachapi

The City of Tehachapi is located in central Kern County, in south-central California. It is surrounded by unincorporated Kern County land. The City of Tehachapi, incorporated in 1909 with a population of 520, had 3,960 inhabitants in 1979. In 2000, the City of Tehachapi had a population of 10,957 (U.S. Census Bureau, Profile of General Demographic Characteristics for City of Tehachapi, 2000).The corporate limits encompass 4.7 square miles, approximately 27 percent of which is developed. The city lies on one of the major trans-Sierra routes and serves as a tourist stopover, as well as a commercial center, for the surrounding area (D.W. Lantis, R. Steiner, and A.E. Karinen, 1977). Although some economic activity is generated by the manufacturing and government sectors, agriculture is by far the most important activity. Dryland farming and livestock raising account for most agricultural land use. Irrigation produces high value crops, such as deciduous fruit, alfalfa seed, safflower, potatoes, and turf grass sod (U.S. Dept. of Agriculture, 1975 and 3 U.S. Dept. of Agriculture, 1978). The city is served by State Highway 58, the Southern Pacific Railroad, the AT&SF Railway, bus lines, and a county airport (Tehachapi Soil Conservation District, Tehachapi Project Report, March 31, 1969). The City of Bakersfield, the county seat, is approximately 40 miles to the northwest.

The flood plains within the City of Tehachapi are residentially and industrially developed. Tehachapi lies at an approximate 4,000 feet elevation in an intermontane valley at the juncture of the Sierra Nevada and the Tehachapi Mountains. The area is geologically complex with igneous and metamorphic formations overlain by sedimentary, pyroclastic, and volcanic rocks (Tehachapi Soil Conservation District, Tehachapi Project Report, March 31, 1969). The valley floor is dominated by alluvial deposits from granitic sources on the north and metamorphic sources on the south side. Soil types are complex, and most valley soils are deep and well developed (California Department of Soils and Plant Nutrition, Soils of the Tehachapi Area, April 1966).

The uplands surrounding the valley are drained by a number of ephemeral streams that discharge onto alluvial fans at the canyon mouths. Active faults in the region include the Garlock, the White Wolf, and the San Andreas.

The climate of the Tehachapi valley is Mediterranean, with cool, wet winters and warm, dry summers, modified by elevation and inland location. Summer temperatures are moderate and on the average, only 36 days per year have temperatures above 90°F. Winter temperatures are cool, and light snows fall in the valley from December through March. Average annual precipitation is 10.17 inches, 85 percent of which occurs from November through April. Occasional convection storms in August and September produce intense rainfall. The 156-day growing season (April 28 to October 13) falls during the dry period (Tehachapi Soil Conservation District, Tehachapi Project Report, March 31, 1969 and Tehachapi Soil Conservation District, 1964).

The natural vegetation of the region is varied, occurring in a transition zone between the Sierra Nevada, the Tehachapi Mountains, the San Joaquin Valley, and the Mojave Desert. According to a 1964 survey, four major plant associations merge in the area: desert shrub, California prairie, oak woodland, and pinon-juniper woodland (Tehachapi Soil Conservation District and Tehachapi Comprehensive Planning Project, 1964).

City of Wasco

The City of Wasco is located in the fertile farm lands of the southern San Joaquin Valley in Kern County, about 27 miles northwest of Bakersfield, 120 miles north of Los Angeles, and 275 miles south of San Francisco. The city is situated on the eastern side of the valley floor about 345 feet above sea level (City of Wasco Planning Department, June 1987). The population of Wasco was 11,050 in January 1987, which is a 34-percent increase from 8,269 in 1970 (Department of Finance, Population of California Cities, January). In 2000, the City of Wasco had a population of 21,263 (U.S. Census Bureau, Profile of General Demographic Characteristics for City of Wasco, 2000).

The area within the corporate limits of Wasco was 661.7 acres in 1963 excluding street right-of-ways. Of this area, 53.3 percent was classified as low and medium density residential. Industry and railroads comprised 16.9 percent, and commercial comprised 8.5 percent. The remaining 21.3 percent was classified for public and quasi-public uses such as parks and recreation, schools, hospitals, fire stations, parking, etc. (Williams and Mocine: City and Regional Planning, 1990, 1963). The land use figures in the Wasco General Plan 1990 (Williams and Mocine: City and Regional Planning, 1990, 1963) projected the following land use percentages until 1990: (1) total acres excluding street right-of-way is 1,987; (2) of the 1,987 acres, 62.2 percent is used for low and medium density residential use; (3) industry and railroad comprises 22.4 percent; (4) commercial comprises 3.8 percent; and (5) public uses and quasi-public uses account for 11.6 percent.

The climate in Wasco is typical of the southern San Joaquin Valley, which is relatively hot and arid. Temperatures range from an average low of 45°F in winter to an average high of 82°F in summer. The average annual rainfall is 6.24 inches, and the prevailing wind is from the north-northwest, averaging 10 to 15 miles per hour (City of Wasco Planning Department, June 1987).

Geologically, the entire Wasco area is composed of sandy loam soil of high fertility. This soil is approximately 800 feet deep (Williams and Mocine: City and Regional Planning, 1990, 1963). Drainage for the area is not adequate to prevent ponding.

2.3 Principal Flood Problems

Kern County

Flooding results from a variety of conditions in Kern County. Intense storms can cause high flood peaks that pass rapidly, but can leave severely damaged property in their wake. Spring snowmelt often results in high flows that have a longer period of runoff and a lower peak than rain floods. Overflow from poorly defined channels and inadequate culverts and drains can lead to shallow flooding, even from low-intensity rainfall.

Various areas in Kern County have suffered from numerous floods. Severe flooding occurred in November 1950, December 1966, January and February 1969, and September 1975. Localized flash flooding occurred in September 1976, and a large storm produced high flows on various streams occurred in February 1978. A large storm in March 1983 in the mountains of the Caliente Creek watershed caused extensive flooding of the Caliente Creek area near the cities of Arvin and Lamont.

A series of storms during November 1950 produced widespread flooding throughout the Sacramento and San Joaquin River basins in California, and the Truckee, Carson, and Walker River basins in California and Nevada. At many localities, these floods were the most destructive experienced over the 40- or 2-percent annual chance period of record (U.S. Department of the Army, Corps of Engineers, 1951).

Peak flow on the Kern River at the First Point gage (located 6 miles upstream of Bakersfield) was 36,000 cfs. This flow occurred 4 years before Isabella Dam was constructed, and would have a recurrence interval of approximately 670 years under current, regulated conditions. Bakersfield was saved from damage by intensive flood fighting; however, part of neighboring Oildale, the Fruitvale oilfield, and agricultural areas were flooded, and Gordon's Ferry Bridge was washed out. Approximately 37,000 acres were flooded along the entire length of the Kern River, and flood damage totaled nearly $2,000,000 (U.S. Department of the Army, Corps of Engineers, 1951). Some areas along Poso and Caliente Creeks also were flooded.

An intense 48-hour storm on December 4 through December 6, 1966, caused severe flooding in a 60- by 100-mile area in the Sierra Nevada range northeast of Bakersfield. The Kern, Tule, and Kaweah River basins were affected. Damage was extensive in all headwater areas of these three stream systems. The road from Kernville upstream of Johnsondale along the Kern River was obliterated at the outside bank of many river bends, and the pavement was scoured away in other locations. Water stage recorder structures and the measuring cableways on the Kern River at Kernville and South Fork Kern River near Onyx were destroyed by the flood (W. W. Dean,, 1971). Further downstream, Isabella Dam minimized flood damage to the valley. Peak flow along the Kern River was 60,000 cfs; more than twice the previous maximum that occurred in November 1950 (W. W. Dean, 1971). The USACE estimated that flow on the Kern River at the First Point gage would have been approximately 80,000 cfs, if Isabella Reservoir not been in operation (U.S. Department of the Army, 1969). Actual flow was nearly 9,300 cfs, which has a recurrence interval of approximately 80 years. Areas along Caliente Creek also were flooded, resulting in $625,800 in damage to urban and rural property.

Storms occurring January 18 through January 22 and January 24 through January 27, 1969, produced heavy rainfall that caused extensive flooding in the San Joaquin Valley. Flows in the Kern River at Kernville were one-third of the record flows in 1966, but were the third or fourth highest of record (U.S. Department of the Interior, 1969). A storm that lasted from February 22 through February 24, 1969, brought heavy rain into the southern and western portions of the San Joaquin Valley. Poso Creek near Oildale had a peak discharge of 6,600 cfs on February 24, 1969. This flow has a recurrence interval of approximately 22 years. Nearly 38,000 acres were inundated by this stream (Kern County Water Agency, 1368 and 1969). On February 25, 1969, El Paso Wash, just down-stream of Inyokern Road in Ridgecrest, had an estimated flood peak of 350 cfs (U.S. Department of the Army, Corps of Engineers, June 1976). This flow has a recurrence interval of approximately 13 years.

Major flooding occurred in Kern County on September 9 through September 10, 1975. High-intensity thunderstorms passed over the northeastern part of the county, causing flooding at Isabella and in the desert areas. Unusually high flood peaks, some estimated to be in excess of the 1-percent annual chance flood, were gaged from high-water marks on various streams following the storm (Kern County Water Agency, Annual Reports, 1974 and 1975).

Between September 29 and October 1, 1976, flash flooding occurred within the South Fork Kern River and Kelso Creek Valleys, and in the Pinte Mountains. Flooding was caused by thunderstorms that moved easterly across the southern area of Lake Isabella. Erskine Creek had a peak discharge of 2,660 cfs causing damage to Uffert Park. This flood has a recurrence interval of approximately 28 years. The KCWA Improvement District No. 3 levees along Kelso Creek were severely damaged by a peak discharge of 11,200 cfs. This flow has a recurrence interval of approximately 50 years, and is 1 and ½ to 2 times the levee design flood (Kern County Water Agency, 1958-1976, 1977).

A large storm in February 1978, produced a peak flow of approximately 8,300 cfs on the Kern River at the First Point gage near Bakersfield. This flow has a recurrence interval of slightly greater than 70 years. Preliminary data from unpublished records of the USGS and KCWA indicate that the peak flow on Poso Creek near Oildale was 3,570 cfs on February 10, 1978 (U.S. Department of the Army, Corps of Engineers, 1979). This flow has a recurrence interval of slightly less than 11 years.

In early March 1983, the Loraine area was severely flooded, causing damage to many of the structures in the floodplain. The bridge crossing of Indian Creek just above the confluence of Caliente Creek and Indian Creek was completely washed out, as was most of Caliente Creek Road below this confluence point. These problems were mainly due to flows approaching the 1-percent annual chance discharge.

Inyokern has also been flooded in recent years. In August 1984, flooding occurred as water flowed down Little Dixie Wash to the Inyokern Road and Southern Pacific Railroad crossings. At these crossings, the water ponded and was diverted northerly down the west side of Inyokern Road. Flow then spread out as it passed through Inyokern.

The main flooding problems in Mojave can be attributed to overflow from poorly defined channels and obstructed or undersized culvert crossings. Because of these problems, shallow flooding can occur even during lower intensity storms.

Flooding problems throughout Kern County are aggravated by undersized or insufficient drainage facilities. Even large culverts and bridges may become constricted by debris during flood events. In addition to flooding from washes, creeks, and rivers, many areas are subject to flooding from flows on alluvial fans. Both unpredictability of flow paths on alluvial fans and typically high sediment loads compound the problem.

In the revisions within the unincorporated areas of Kern County, major floods from small watersheds in the vicinity of Bodfish Creek and East Nicolls Peak typically result from summer cloudburst storms. Damage-causing storms of recent history occurred in September of 1976 and July and August 1984 (U.S. Department of Commerce, 1984 & Kern County Department of Planning and Development Services, no date, U.S. Department of Commerce, 1984 and Kern County Department of Planning and Development Services). Vegetation was ruined in approximately half of the Bodfish watershed. Bodfish Canyon Road was blocked at numerous locations by mud flows from Bodfish Creek, which deposited approximately 6 inches of mud on affected properties. The surface of Upper Bodfish Canyon Road at the crossing of Bodfish Creek was washed away by floodflows. All road crossings of Bodfish Creek were overtopped, which resulted in water being diverted down the roads. About 25 acres of commercial and residential land north of Isabella Boulevard were flooded to a depth of less than 0.5 foot.

There has not been any road damage caused by flood flows from the East Nicolls Peak Watershed in the past 25 years. However, approximately once in 5 years a storm will deposit a few inches of alluvial material on Kelso Valley Road (Telephone conversation with Mike Ansolabehere, 1988).

City of Arvin

Results of the mapping study were not previously summarized in an effective FIS report for the City of Arvin; therefore, no principle flood problems are provided.

City of Bakersfield

The most severe flooding problems on the Kern River near Bakersfield result from high intensity winter rainstorms which generally occur from November through March. Snowmelt floods, which usually occur in late spring and early summer, have a longer period of runoff and a lower peak than rain floods. As a result, they rarely cause significant damage.

The flood of 1937 was the largest flood recorded to that time. Inundation of Bakersfield was narrowly averted because a further rise of less than 1 foot would have overtopped the levees protecting the city. The Fruitvale and Fairhaven areas were flooded. Fifty persons had to be evacuated and their homes were badly damaged. In other areas crops were lost, stocks were drowned, and roads, grazing land, and oil production facilities were damaged. The Kern River flow at the First Point gage was 20,000 cfs. The recurrence interval under current, regulated conditions would be 286 years. Most recently, a large storm in February 1978, produced a peak flow of approximately 8,300 cfs at the First Point gage. This flow has a recurrence interval of slightly greater than 70 years.

Flooding in the Hawthorne Ravine-Wilshire Heights area occurs when runoff on the streets exceeds storm drain capacity. In June 1972, runoff from an intense thunderstorm flooded streets, houses, and apartment buildings in the study area. Damage throughout Bakersfield was estimated at $340,000, including $200,000 to streets, parks and

freeways, and $49,000 to residential areas. A recurrence interval for June 1972 flows in the Hawthorne Ravine-Wilshire Heights area could not be estimated due to the lack of required data. No data on historic floodflows in Cottonwood Creek were located.

Factors which tend to aggravate flooding problems in Bakersfield include diversion weirs on the Kern River and low spots on streets in the Hawthorne Ravine-Wilshire Heights area which have no outlet for runoff except through private property.

City of California City

Major flooding in California City is caused by overflow from Cache Creek. Flooding of a lesser magnitude may occur from overflow of Tierra del Sol Creek. Because California City is located at the eastern toe of an alluvial fan, shallow flooding (average depth 1 foot) will occur around Yerba Rusche and Great Circle Creeks in the western part of the city.

Records are unavailable to indicate the maximum or most recent floods for Cache and Tierra del Sol Creeks. The most recent known flood in the community was in the winter of 1977-1978 on Yerba Rusche Creek. This flood had an estimated recurrence interval of 10 years.

Cache Creek enters the city from the southwest and flows northeasterly. Except near culverts, the channel is poorly defined. Flooding problems are compounded by low-capacity culverts causing flow over roadways. Tierra del Sol Creek has a more defined channel because of recent improvements and current maintenance. Nevertheless, storms producing high discharge will cause overbank flooding and flow over roadways due to inadequate culvert capacities along Tierra del Sol Creek.

City of Delano

Results of the mapping study were not previously summarized in an effective FIS report for the City of Delano; therefore, no principle flood problems are provided.

City of Maricopa

Results of the mapping study were not previously summarized in an effective FIS report for the City of Maricopa; therefore, no principle flood problems are provided.

City of McFarland

Major flood problems on the eastern side of the City of McFarland result from the overflow of Poso Creek and runoff from the mountains east of McFarland. The runoff ponds behind the Friant-Kern Canal and then flows southerly along the east canal bank. Both the overflow from Poso Creek and runoff from the canal, flow northerly toward McFarland through a siphon beneath State Highway 99. East of State Highway 99, there are overland flows with an average depth of less than 1 foot. Past flooding of the east side of the city, as recently as 1978, was the result of these two sources of flooding.

In addition, the city is subject to 1-percent annual chance runoff from the east resulting from flow overtopping the canal levee. The canal levee would fail if overtopped. Therefore, once the canal is breached, runoff from the east would spread out and flow into the City of McFarland. No flows have overtopped the canal levee since its opening in 1953, but water has ponded near the top of the levee.

City of Ridgecrest

Major flooding in Ridgecrest results from sheet flow. Natural drainage channels are poorly defined, and flows tend to follow street patterns, and ponds behind embankments and inadequate culverts. Much of the volume of the flows carried by Ridgecrest and El Paso Washes is prevented from entering the city by the embankments of the Southern Pacific Railroad and the new U.S. Highway 395. Only the drainage area downstream of these barriers contributes significantly to peak flows in Ridgecrest (U.S. Department of the Army, Corps of Engineers, June 1976).

In approximately 30 years of observation, the most severe conditions of flooding within Ridgecrest occurred on February 25, 1969, and July 23, 1974. The 1969 peak at El Paso Wash just downstream of Inyokern Road was estimated to be 350 cfs (U.S. Department of the Army, Corps of Engineers, June 1976). This flow is approximately equivalent to a 13-year recurrence interval.

City of Shafter

There are no riverine flooding problems in Shafter. Flooding along Walker and James Streets is due to ponding of overland flow originating outside the city.

City of Taft

Flooding in the City of Taft can be attributed primarily to high intensity summer thunderstorms.

City of Tehachapi

The two major streams responsible for flooding in the City of Tehachapi are Antelope and Blackburn Creeks. Antelope and Blackburn Creeks do not have defined channels on the valley floor. Floodwaters flow across agricultural land and into the City of Tehachapi, finally emptying into Tehachapi Creek northwest of the city. According to the NRCS, "the course of floodflows may vary from storm to storm and areas subject to flooding and deposition of sediment are not identical in all storms" (U.S. Department of Agriculture, Soil Conservation Service, March 1966). Streams in the eastern one-half of the valley do not contribute to floodflows in the city because a slight drainage divide directs flows eastward into Proctor Lake (U.S. Department of Agriculture, Soil Conservation Service, September 1975).

The most severe floods occurring in Tehachapi since 1900 were in 1932, 1938, and 1945. All three were of approximately the same magnitude (U.S. Department of Agriculture, Soil Conservation Service, March 1966). Lives were lost in the 1932 and 1945 floods. An analysis of stream gage records shows that these floods had a 4.5 percent chance of occurrence, equivalent to a 22-year recurrence interval (U.S. Department of the Interior, Geological Survey, Recorded Maximum Flows, 1963-1978, Gage 11-196420, Tehachapi Creek near Tehachapi). Since 1931, most flooding has resulted from convection storms occurring from August to October (U.S. Department of Agriculture, Soil Conservation Service, September 1975). Recent flooding in Tehachapi occurred in February and March 1978. Damage included severe road washouts, structure and property destruction, and one related death (U.S. Department of Agriculture, Soil Conservation Service, 1978).

City of Wasco

There are no riverine flooding problems in Wasco. Potential flooding along the east side of the city could occur due to the ponding of overland flow originating outside of the city.

2.4 Flood Protection Measures

Kern County

Levees exist in Kern County that provide the community with some degree of protection from flooding. However, it has been ascertained that small levees, such as those constructed to confine water to irrigation canals (U.S. Department of the Army, 1969), may not protect the community from rare events, such as the 1-percent annual chance flood. The criteria used to evaluate protection from the 1-percent annual chance flood are: (1) adequate design, including freeboard; (2) structural stability; and (3) proper operation and maintenance. Levees that do not provide protection from the 1-percent annual chance flood are not considered in the hydraulic analysis of the 1-percent annual chance floodplain.

In 1971, the California Department of Transportation (CALTRANS) constructed improvements to State Highway 58 from Boron Avenue to the eastern Kern County boundary. These improvements include a trapezoidal earthen channel running along the northern side of the freeway. The channel maximum design capacity of 600 cfs is not adequate for 1-percent annual chance floodflows.

Kern County also participates in a comprehensive flood-damage reduction program. For streams having drainage areas larger than 10 square miles, the KCWA has jurisdiction. Streams draining less than 10 square miles are the responsibility of the Kern County Department of Public Works.

Flooding conditions in some areas have been improved with the installation of temporary flood-control structures by various agencies and property owners. Major public and private improvements, such as the Antelope Valley Freeway (State Route 14), the Southern Pacific Railroad, and the Los Angeles Aqueduct have provided for the passage of floodflows. However, the relatively sparse and scattered development of Kern County communities has made the construction of major flood control facilities economically unfeasible.

In 1970, the KCWA, in cooperation with the USACE, completed the Kelso Creek Levee Project. The levee constructed as part of this project does not provide 1-percent annual chance flood protection. In 1983, the levee experienced more than $200,000 in damage from flooding along Kelso Creek. Other improvements include those along Cuddy Creek, where gabions through several sections have been used to stabilize the channel and prevent excessive erosion.

The KCWA approach to reducing flood damage includes both floodplain management and structural measures. To assess the nature and magnitude of flood hazards, the KCWA prepares hydrology and flood-frequency studies, special storm reports, and flood area delineations. To broaden the stream flow data base, the KCWA also participates in a cooperative stream-gaging program with the USGS. The major result of KCWA activities in flood-damage mitigation was the adoption of a floodplain zoning ordinance in May 1975 (Kern County Water Agency, Annual Reports, 1974 and 1975).

In the revisions within the unincorporated areas of Kern County, there are no structural flood protection measures that exist or are currently planned for either Bodfish Creek or the East Nicholls Peak Area.

City of Arvin

Results of the mapping study were not previously summarized in an effective FIS report for the City of Arvin; therefore no flood protection measures are provided.

City of Bakersfield

At Bakersfield, flood-control levees have been constructed on both sides of the Kern River to protect the city from flooding. These flood-control levees contain the 1-percent annual chance flood, and in some places, the 0.2-percent annual chance flood, and extend for approximately 4 miles along the southern bank and 2.5 miles along the northern bank (U.S. Department of the Army, 1969). Additional levees are located along the Cross Valley Canal on the north bank of the Kern River. The levees provide less than 3 feet of freeboard with respect to the 1-percent annual chance flood in the areas along the north bank between Stockdale Highway and Rosedale-Rio Bravo Canal, and along the south bank from Stockdale Highway upstream approximately 9,000 feet. In other areas, there are more than 3 feet of freeboard between the top of the levees and the 1-percent annual chance flood. Smaller levees have been built to confine water to irrigation canals. These small irrigation canal levees do not provide significant flood protection (U.S. Department of the Army, Corps of Engineers, October 1969).

Recent channel improvements have been made to the Kern River between Friant-Kern Canal and the AT&SF Railway bridge. These improvements involved the construction of Coffee Road bridge, a diversion structure upstream of Coffee Road, Carrier Canal and adjacent levees, and the extension of Truxtun Avenue.

A storm drain system has been constructed in the Hawthorne Ravine-Wilshire Heights area (Mason, Vancuren & Wachob, Preliminary Engineering Report, June 1973). The system has a 25-year flood capacity. No flood-protection measures are known to exist along Cottonwood Creek.

Isabella Dam and Reservoir, completed by the C0E in 1954, is the major flood-protection facility for Kern County. The 185-foot-high, 1,695-foot-long earthfill dam holds a maximum of 570,000 acre-feet of water. Isabella Reservoir extends approximately 8 miles upstream on Kern River, and the same distance up the South Fork Kern River Valley.

The City of Bakersfield presently has a flood plain ordinance in its zoning ordinance regulations. This flood plain ordinance strictly prohibits any development in the flood plain primary zone which would encroach into the channel, obstruct the natural flow of water, or would in any way endanger life or property. It allows limited development in the flood plain secondary zone upon approval or conditional approval by the planning commission and board of supervisors. At this time, the city is in the process of updating their flood plain ordinances and flood plain development plan.

City of California City

At the City of California City protection from small-magnitude flooding in certain areas is provided by streets and by Tierra del Sol and Yerba Rusche Creeks. Both creeks have well-maintained trapezoidal channels. Typical culverts are effective for low flows, but are generally inadequate to handle 10-percent annual chance flows.

The City of California City has an ordinance restricting building within the 1-percent annual chance flood plain as designated on the FIRM for California City (U.S. Department of Housing and Urban Development, April 1977). There are no Federal, State, County, or local flood-control projects in the community.

City of Delano

Results of the mapping study were not previously summarized in an effective FIS report for the City of Delano; therefore no flood protection measures are provided.

City of Maricopa

Results of the mapping study were not previously summarized in an effective FIS report for the City of Maricopa; therefore no flood protection measures are provided.

City of McFarland

At the City of McFarland protection from major flood events less than the 1-percent annual chance event is provided by the Friant-Kern Canal and its built-up bank. Runoff from the mountains, located east of McFarland, ponds against the east bank of the canal. Flap gates allow water to enter the canal and be carried away. Under major events, the canal cannot carry away enough flow to keep the water from flowing south to the opening at State Highway 99 and north toward the city.

Protection from local runoff is provided by a catch basin located just east of State Highway 99, north of Perkins Avenue. This basin holds local runoff, but does not have capacity to store major flows. For purposes of this study, the basin will be considered full and ineffective for flood control.

There are no planned or existing flood protection structures or programs in Ridgecrest other than storm-drainage systems and streets used to channel floodflows. Sheet flow occurs over much of the incorporated area of the city where existing natural channels become inadequate or are nonexistent, causing floodwaters to spread and inundate large areas. The City of Ridgecrest does mitigate shallow flooding in requiring new development to be elevated at least 1 foot above the curb elevation.

City of Ridgecrest

There are no planned or existing flood protection structures or programs in Ridgecrest other than storm-drainage systems and streets used to channel floodflows. Sheet flow occurs over much of the incorporated area of the city where existing natural channels become inadequate or are nonexistent, causing floodwaters to spread and inundate large areas. The City of Ridgecrest does mitigate shallow flooding in requiring new development to be elevated at least 1 foot above the curb elevation.

City of Shafter

No structural flood protection measures exist or are currently planned for the City of Shafter other than the existing internal storm drain system. The internal storm drain program includes two detention basins to reduce peak storm drainage discharges. These basins are located near East Euclid Street and near the intersection of South Shafter Avenue and Los Angeles Street.

City of Taft

No significant flood protection measures have been constructed in the City of Taft.

City of Tehachapi

The Tehachapi-Cummings County Water District operates two flood- control improvement districts that include debris basins, flood channels, and a diversion-detention reservoir, all completed during 1968 to 1969 (Tehachapi-Cummings County Water District, June 7, 1976). These improvements provide some protection for the western half of Tehachapi from heavy damage during a 1-percent annual chance event. The NRCS reports that these improvements have been effective during recent storms, although none of the flooding has been of a magnitude equaling or exceeding a 1-percent annual chance flood (U.S. Department of Agriculture, Soil Conservation Service, April 1978). In addition, an unlined trapezoidal channel of small capacity conveys nuisance flows from Blackburn Creek northwesterly around the Tehachapi-Kern County Airport.

The NRCS has completed a watershed plan recommending structural measures that include channels and two floodwater-retarding structures, one on Antelope Creek and one on Blackburn Creek. The former will contain the flows of a 1-percent chance (1-percent annual chance) event; the latter will contain the flow of a 4-percent chance (25-year) event.

The City of Tehachapi is participating in the National Flood Insurance Program. As part of the program, the city has adopted a local flood plain management ordinance regulating development in the flood plain. The city also reviews improvement plans for structural requirements within the flood plain.

City of Wasco

No structural flood protection measures exist or are currently planned for the City of Wasco.

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 are expected to be equaled or exceeded once on the average during any 10-, 2-, 1-, or 0.2-percent annual chance 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 annual chance, respectively,

of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at shorter 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 100-year flood (1-percent chance of annual exceedence) in any 2-percent annual chance 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.

Information on the methods used to determine peak discharge-frequency relationships for the streams studied as part of this countywide FIS is shown below.

Each incorporated community within, and the unincorporated areas of, Kern County, with the exception of the cities of Arvin, Delano, and Maricopa have a previously printed FIS report. The hydrologic analyses described in those reports have been compiled and are summarized below.

Kern County

For the alluvial fan and shallow-flooding studies for the Mojave area, a review of existing stream gage information showed insufficient record length and no hydrologically similar watersheds in the area. 1-percent annual chance peak discharges were determined by using the KCWA regression equations. The “R” values used in the analysis were provided by the KCWA. Infiltration losses were then applied to these streams as they traveled across the alluvial fan areas toward Mojave. This discharge was checked using the USGS equations for the area.

The study contractor developed discharge-frequency values for the following flooding sources: Kelso Creek, Erskine Creek, Breckenridge, Doyle Street, Ward Street, and Hawthorne Avenue. The analyses used NRCS Technical Release No. 20 (TR-20) Computer Program for Project Formulation-Hydrology (U.S. Department of Agriculture, 1965). This is a rainfall-runoff model that considers factors such as precipitation-duration-frequency data, hydrologic soils groups and land use, time of concentration, and storm type. The study contractor compared results from the TR-20 computer model with the results of log-Pearson Type III analyses of nearby gaging station data (U.S. Water Resources Council, 1977).

Discharge-frequency values for Cane Canyon, Chollo Canyon, and Short Canyon Creeks were developed by the KCWA. At the confluence of each of these three creeks with Kelso Creek, the discharges presented in this study present an approximate 80-percent reduction in the estimated total discharge. This was done to account for deposition of sediment along the creeks’ flow paths (Kern County Water Agency, April 1985).

Discharge-frequency values for the Kern River at Kernville and the South Fork Kern River were developed for gaging station data. The study contractor extended the 24-year record of USGS gaging station No. 11-187000 to 66 years, using the record of an upstream station. The two-station comparison was made in accordance with the procedure outlined in the U.S. Water Resources Council Bulletin 17A (U.S. Water Resources Council, 1977). The study contractor then performed a log-Pearson Type III analysis on the extended data.

The study contractor developed discharge-frequency values for the following flooding sources: Upper Sycamore Creek, Cuddy Creek, and the lower reach of Caliente Creek. The NRCS conducted the hydrologic analyses for Blackburn and Antelope Creeks. All flooding sources were studied using the TR-20 computer model (U.S. Department of Agriculture, 1965). The results from the TR-20 computer model were compared with results of log-Pearson Type III analyses of nearby gaging stations (U.S. Water Resources Council, 1977). A flow split occurs on Caliente Creek downstream of State Highway 58. The distribution of peak flows in each branch was calculated during the hydraulic portion of the study.

For the detailed study of the upper reach of Caliente Creek near Loraine, discharges were taken from the hydrology performed as part of the initial FIS (Federal Emergency Management Agency, March 1984). These discharges were confirmed using a statistical analysis of discharge records covering a 22-year period at the Caliente Creek gaging station operated by the USGS (Kern County Water Agency, October 1983). This analysis followed the standard log-Pearson Type III method, as outlined by the U.S. Water Resources Council (U.S. Department of the Interior, September 1981).

The USACE developed discharge-frequency values for Poso Creek (U.S. Department of the Army, Corps of Engineers, 1980). The USACE extended the 20-year stream gage record on Poso Creek to 32 years (U.S. Department of the Interior, 1958-1978) by regional correlation analyses using the USACE Hydrologic Engineering Center's Generalized Computer Program HEC-1 computer program (U.S. Army Corps of Engineers, September 1981, Revised January 1983). The HEC-1 model was designed to simulate the surface-runoff response of a watershed to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components. Program input includes sub-basin area and lag routing parameters. A log-Pearson Type III analysis was made on the extended data to obtain discharge-frequency values at the gaging station (U.S. Water Resources Council, 1977). These values were used to calibrate the USACE HEC-1 rainfall-runoff model that generated peak flows for other concentration points on Poso Creek (U.S. Department of the Army, Corps of Engineers, 1979). The study contractor developed discharge-frequency values for Blackwells Corner, Sandy Creek, and along State Highway 99 near McFarland and used the TR-20 computer model (U.S. Department of Agriculture, 1965). The results from the TR-20 computer model were compared with results of log-Pearson Type III analyses of nearby gaging stations (U.S. Water Resources Council, 1977).

The revision of unincorporated areas of Kern County includes the study of Bodfish Creek and East Nicolls Peak alluvial fan. It was incorporated in this Section in 1989 to update the September 26, 1986, Kern County FIS. In these revisions, Bodfish Creek drains an area of 16.6 square miles. It flows to the northwest where it discharges into the Kern River about 3 miles downstream of Isabella Reservoir.

Frequency discharges for Bodfish Creek have been determined in the past using a regional regression equation developed by the KCWA (Kern County Department of Planning and Development Services, 1987). In 1975, the 1-percent annual chance discharge at a concentration point of 15.9 square miles was determined to be 5,500 cfs by regression equation. This was revised to 4,400 cfs in 1983 for the same point of concentration. Following record flooding in the summer of 1984, the KCWA revised the 1-percent annual chance discharge to 13,800 cfs at the upstream crossing of Bodfish Canyon Road. The drainage area at this point is 7.7 square miles. USGS gage 11191600, "Bodfish Creek near Bodfish," located near this same road crossing, has been in operation since 1974. It was washed out during the floods of 1984 but a record peak discharge of 3,500 cfs was determined by the slope area method (Kern County Water Agency, 1985).

Because of the extreme variation in previously determined discharges it was not possible to adopt one without further analysis. The record of measured flow is not of sufficient length to support a flow frequency analysis.

The Bodfish Watershed lies close to the boundary between two regions having significantly different USGS regression equations (U.S. Department of Commerce, 1984). The regression equation applicable within the Sierra Region and South Lahontan-Colorado Desert Region yield 640 cfs and 4,610 cfs respectively at the site of the stream-flow gage.

The adopted procedure was to use HEC-l (U.S. Department of the Army, 1985). The watershed was subdivided into five sub-basins. Unit hydrographs were developed using a method developed by the USACE. This method utilizes a dimensionless S-curve unit hydrograph and a relationship that relates lag time to various physical parameters of the watershed. A study of the adjacent Caliente Creek Watershed was used as a basis for the selection of the Caliente S-curve and some additional hydrologic parameters (U.S. Department of the Army, 1980 & 68). An average watershed roughness factor ("n") of 0.05 was adopted for all five sub-basins.

The spatial distribution of the standard project cloudburst storm was adopted to spatially distribute the 1-percent annual chance, 3-hour storm depth. The storm depth and a time distribution were developed from the rainfall statistics of the gage at Clenville Fulton Ranger Station. A constant infiltration rate of 0.1 inch/hour was adopted based on a description of the soils. Routing travel times were determined from preliminary results of the hydrologic analysis performed using HEC-1 (U.S. Department of the Army, 1985). Calibration of the model to the flood events of the summer of 1984 was attempted but was not possible due to the extremely localized nature of the cloudburst cells and the compounding effect of the burned condition of about half of the watershed.

The resulting 1-percent annual chance peak discharge near the site of the stream gage and at the Kern River are 3,780 cfs and 8,530 cfs, respectively. These flows have not been factored to account for bulking. The un-bulked discharges are already significantly higher than those adopted prior to the 1984 flooding. The extreme value of 13,800 cfs developed after the 1984 flooding is difficult to support when compared to the USGS regression of 35 gaged stations in the South Lahontan-Colorado Desert Region (U.S. Geological Survey, 1911). A discharge of this magnitude would approach record proportions in Southern California and may reflect the results of a burned watershed condition. The Los Angeles District USACE does not combine the effect of a burn with the occurrence of a 1 percent probability rainfall event (Telephone conversation with Dennis Maurice, 1988).

The watershed on the east side of Nicolls Peak forms an alluvial fan. The drainage area upstream of the fan is 625 acres. An additional 430 acres contributes runoff to the fan between the appex and Kelso Valley Road. In the application of the alluvial fan analysis calculations were made using the hydrology of both the area at the apex and the larger area down fan of the apex. However, the consideration of the larger flows down fan did not affect the depth or velocity zone boundaries and hence these discharges are not presented.

Because of the low annual rainfall in the watershed (less than 10 inches per year) and the resulting dry soil conditions, runoff from storm events as frequent as the 2- or 10-percent annual chance return interval, is significantly influenced by the infiltration rate. Because of the difficulty of establishing a reliable infiltration rate regression equations were used to determine the 2- and 10-percent annual chance discharges. The regression equations developed by the USGS (U.S. Geological Survey, 1911) for the region called "South Lahontan-Colorado Desert (SL-CD)" region was adopted. The resulting 2- and 10-percent annual chance discharges are 7 cfs and 150 cfs respectively. The 1-percent annual chance flow of 1,080 cfs resulting from the SL-CD equation was significantly lower than the 5,400 cfs which would result from the regression equation developed by the KCWA (Kern County Department of Planning and Development Services, 1987). To determine a conservatively higher discharge than that determined by the SL-CD regression equation, the rational method was applied assuming extreme conditions; 100 percent runoff, short time of concentration which is supportable, and rainfall intensity determined from the rain gage at Glenville Fulton Ranger Station, which typically experiences more intensive rainfall than most of the gages in the eastern portion of Kern County. The resulting adopted 1-percent annual chance discharge at the fan apex is 1,537 cfs. The untransformed mean, standard deviation and skew of the logarithm of flows are 0.860, 1.00 and 0.0 respectively.

An additional revision of this study was completed on March 2, 1994, to provide flood hazard information based on new analyses of flooding on Freeman Gulch, Grapevine Canyon, Indian Wells Canyon, Sand Canyon, Short Canyon, and Short Canyon at Kelso Creek.

The flood-frequency curve for each source of alluvial fan flooding was taken to be log-normal. Means were computed from the USGS Equation for the South Lahontan-Colorado Desert Region. Standard deviations were computed from the means and 1-percent annual chance discharge values determined using the Rational Equation. Revised peak discharges for Sand Canyon, Grapevine Canyon, Short Canyon, and Indian Wells Canyon are presented in the Summary of Discharges (Table 5).

City of Bakersfield

The USACE made a flow-frequency analysis of the Kern River near Bakersfield (U.S. Department of the Army, Corps of Engineers, January 1979). However, at the request of the study contractor, the USACE revised its analysis to exclude the adjustment for expected probabilities. The revised flood peaks were used in this FIS.

The peak discharges for Cottonwood Creek and the Hawthorne Ravine-Wilshire Heights area were calculated using a rainfall-runoff model (U.S. Department of Agriculture, Soil Conservation Service, 1965). Rainfall depths and intensities were obtained from published data (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1973 and U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Hydrology, Supplement 1, 1972).

Runoff calculations considered existing land use and soil types. The results of the model agree with an analysis of the 2-percent annual chance peak in the Hawthorne Ravine-Wilshire Heights area made in 1973 (Mason, Vancuren & Wachob, Preliminary Engineering Report, June 1973).

City of California City

At the City of California City, separate discharge-frequency curves for summer and winter events were developed. The curves were then combined to produce a composite discharge-frequency curve for Cache, Tierra del Sol, Yerba Rusche, and Great Circle Creeks flooding sources.

The discharge-frequency curve for summer floods was obtained following a procedure developed by the USACE (U.S. Department of the Army, Corps of Engineers, July 1976). The procedure develops a normalized, regional discharge-frequency curve based on a log-Pearson Type III analysis of gaging station data (U.S. Department of the Army, Corps of Engineers, July 1976, U.S. Water Resources March 1976 and Kern County Water Agency, Cooperative Stream Gaging Program, May 1977, with updates). The average length of record for the stream gages used is 18 years. The regional curve is then transferred to the ungaged flooding source using the Standard Project Flood as a reference point. Standard Project Floods are calculated using the USACE, Los Angeles District, Flood Hydrograph Package (U.S. Department of the Army, Corps of Engineers, Los Angeles District, November 1978).

The discharge-frequency curves for winter floods were developed using regional skew coefficients and relationships derived from the USACE frequency analysis of winter events (U.S. Department of the Army, Corps of Engineers, July 1976). The winter and summer discharge-frequency curves were combined on the basis of probability of occurrence.

City of McFarland

At the City of McFarland, stream channels east of Highway 65 are well defined, but as they approach the Friant-Kern Canal, they become broad flood plains flowing through the local orchards and fields. Stream discharges from the mountains were calculated using the NRCS computer program TR-20 (U.S. Department of Agriculture, Soil Conservation Service, 1965 with updates). The necessary parameters were obtained from field observations (Riverside County Flood Control and Water Conservation District, Hydrology Manual, 1978 and U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1973). The volume of runoff in this area was compared with available storage east of the Friant-Kern Canal to determine the height of water behind the canal's east bank. This height was found to exceed the bank elevations.

According to FEMA guidelines, when water overtops the canal bank, the canal levees are to be instantaneously removed. This procedure will result in an analysis similar to a dam break analysis to determine peak discharge. The NRCS Simplified Dam-Breach Routing Procedure TR-66 (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1973) gives dependable results for dams above 25 feet in height. Below this height, the resultant flow estimates tend to be too conservative. For dams of lesser height, the NRCS uses a weir equation. Assuming a breach length of 20 feet, the discharge through the opening is 1,000 cfs. FEMA policy regarding levees stipulates

that, for the area contained within a levee (i.e. the protected area) providing less than 1-percent annual chance protection, the base flood elevation (BFEs) to be shown is that computed as if the levee did not exist.

The estimated amount of flow needed to produce a 3-foot-deep, 2,500-foot-wide flood in the City of McFarland also was calculated. Such a flood would require a discharge of approximately 36,000 cfs. This value was compared with the maximum value from the dam-breach procedure. Maximum inflow from the drainage areas east of the canal is only 2,550 cfs, and calculations indicate that the discharge through the breach is only 1,000 cfs. Therefore, flooding west of the canal will be shallow, although a small area immediately west of the levee would be susceptible to deeper flooding from the initial breach. Approximately 110 feet west of the bank would be needed for the water from a breach to spread from its initial height to 3 feet or less, assuming a 4:1 expansion ratio.

City of Ridgecrest

The USACE developed discharge-frequency values for the following Ridgecrest flooding sources: North El Paso Wash, Calvert Wash, and North and South Ridgecrest Washes. The USACE developed a normalized, regional discharge-frequency curve based on log-Pearson Type III analyses of gaging station data (Kern County Water Agency,1977; U.S. Department of the Army, Corps of Engineers,1976,1975 & U.S. Water Resources Council, 1977). The regional curve was transposed to select concentration points using the standard project flood calculated from a rainfall-runoff simulation. Alluvial-fan widths for Grapevine Canyon, Short Canyon, and Indian Wells Canyon, near Ridgecrest, were computed for each special flood hazard zone using discharge probabilities from log-Pearson Type III analyses in accordance with Water Resources Council Bulletin 17A (U.S. Water Resources Council, 1977) and FEMA special flood hazard guidelines for alluvial fans. The regional skew coefficient for alluvial fan sources west of Ridgecrest was determined to be 0.2.

The study contractor developed discharge-frequency values for the remaining flooding sources: Claymine Wash, Twentymule Team Creek, Boron Avenue, Little Dixie Wash, and Jawbone Canyon Wash. The same procedure as described above was used to calculate summer peak flows. In addition, the discharge-frequency curves for winter floods were developed using the USACE frequency analysis of winter events (U.S. Department of the Army, Corps of Engineers, July 1976). The winter and summer discharge frequency curves were combined on the basis of probability of occurrence.

For the detailed study area of the upper reach of Little Dixie Wash above U.S. Highway 395, a review of existing stream gage information showed insufficient record length and no hydrologically similar watersheds in the area. Because of the limited data, the watershed was analyzed using NRCS methods and the USACE HEC-1 (U.S. Army Corps of Engineers, September 1981, Revised January 1983). Research into the calculations performed as part of the initial FIS (Federal Emergency Management Agency, March 1984) showed that this analysis yielded very similar discharges for this watershed.

City of Shafter

For the City of Shafter, the hydrologic analyses were performed using the unit hydrograph procedures of the NRCS (U.S. Department of Agriculture, Soil Conservation Service, 1982). The drainage area for the Walker Street detailed study area is 4.9 square

miles. The 4.9 square mile drainage area was subdivided into three sub-basins. NRCS runoff curve numbers were selected for each sub-basin based on the combined hydrologic effect of soil type, land use, and antecedent soil moisture. A 24-hour balanced storm having a 1-percent probability of occurrence was developed from the rainfall statistics obtained from the Bakersfield Airport National Weather Service rainfall gage (State of California, Department of Water Resources, October 1976). The rainfall-runoff computations were determined using the HEC-l computer model (U.S. Department of the Army, Corps of Engineers, 1973).

The ground slope in Shafter is from the northeast to the southwest. The drainage area that would affect the James Street detailed study area is limited by the embankment for the AT&SF Railway track. The drainage area of James Street is less than 0.1 square mile. A survey of ground elevation in the vicinity indicates that a low area does not exist that would cause a ponding area. Past flooding of the area was attributed to inadequate internal drainage.

The 1-percent annual chance runoff volumes have not been previously determined in Shafter by Federal, State, or local agencies and there are no USGS regional equations appropriate to the study area. A drainage study recently conducted for the city (Ricks, Taylor & Meyer, Inc., no date) published a 2-percent annual chance discharge at the point of concentration of the Walker Street detailed study search. The hydrologic procedures discussed in the above paragraph were used to determine a 2-percent annual chance runoff hydrograph, which compared closely with the hydrograph presented in the drainage study.

City of Taft

In the City of Taft, hydrologic analyses used the NRCS Method, TR-20 (U.S. Department of Agriculture, Soil Conservation Service, 1965). Peak flood flows with 10-, 2-, and 1-percent annual chance return periods were computed for tributary drainage areas and the main stream channel within the drainage area.

Precipitation data were obtained from the National Oceanic and Atmospheric Administration Precipitation-Duration-Frequency maps of the state of California (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1973). The 10-, 2-, and 1-percent annual chance, and the 24- and 6-hour precipitation maps provided the basis for estimating the rainfall intensities for each of the sub-drainage areas.

Rainfall intensities were selected based on storm distribution data developed by the NRCS for hydrology analyses (U.S. Department of Agriculture, Soil Conservation Service, Engineering Field Manual, Estimating Runoff in California, Supplement 1, Chapter 2 and 7). Antecedent moisture conditions II and III were used for the computations of the 10- and 1-percent annual chance peaks, respectively. The 2-percent annual chance peaks were obtained by modifying the curve numbers to reflect an intermediate, antecedent moisture condition. For calibration, the results from the TR-20 model were compared with results of log-Pearson Type III analyses of nearby gaging stations.

There are no stream gages on the Taft-Ford City watershed. Therefore, the records of six nearby gages were analyzed. All six have records of at least 14 years, and are located on the west side of the San Joaquin Valley in Kern and Tulare counties. A log-Pearson Type

III analysis was applied to the records, using the regional skew of -0.3 in accordance with U.S. Water Resources Council Guidelines for Determining Flood Flow Frequency (U.S. Water Resources Council, 1977). The resulting discharges were normalized to cfs/mi², and averaged. The mean, normalized flows were then multiplied by the area of the Taft-Ford City drainage to obtain a flood-frequency curve for the watershed. This curve, predicting peak flows for the watershed based on the regional average, was used for calibration.

The 1-percent annual chance peaks of the TR-20 model, USACE analysis, and the calibration curve were then compared with 1-percent annual chance peaks obtained from the log-Pearson Type III analysis of selected Kern County gaging stations. All three estimated 1-percent annual chance peaks lie within the expected limits.

City of Tehachapi

The discharges for the City of Tehachapi were obtained from the NRCS, which used its Project Formulation-Hydrology, TR-20 program (U.S. Department of Agriculture, Soil Conservation Service, January 1964, with updates). This is a rainfall-runoff model which considers factors such as precipitation-duration-frequency data, hydrologic soils groups and land use, time of concentration, and storm type. The NRCS compared results of the TR-20 model to results of log-Pearson Type III analyses of nearby gaging stations (U.S. Water Resources Council, March 1976). Peak discharges at given frequencies were highly correlated.

City of Wasco

In the City of Wasco, The volume of runoff was determined for the 1-percent probability flood. The volume of runoff was determined using rainfall statistics from the Bakersfield Airport National Weather Service rainfall gage located in Bakersfield. A 24-hour storm was adopted to produce the maximum possible volume. A storm of longer duration would not contribute additional runoff due to the relatively high infiltration rate of the soil.

Runoff volumes were determined using NRCS runoff approach (U.S. Department of Agriculture, Soil Conservation Service, 1986.). Watershed characteristics were determined from available mapping (U.S. Department of Interior, Geological Survey, 1973) and a site visit. The soils in the study area are classified as L-Iesperia, Hanford and Delano sandy loam which are all in hydrologic soil group B (U.S. Department of Agriculture, Soil Survey, August 1942). The NRCS runoff curve number was selected to represent the combined hydrologic effect of soil type, land use, agricultural land treatment class, hydrologic condition, and antecedent soil moisture.

The total drainage area contributing to the ponding area is 2.5 square miles. The 24-hour depth of rainfall is 2.15 inches. The volume of computed runoff after infiltration is about 90 acre feet.

Information on the methods used to determine peak discharge-frequency relationships for the streams restudied as part of this countywide FIS is shown below.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 5, “Summary of Discharges.”

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Antelope Creek					
At Tehachapi Western Corporate Limit	25.4	2,730	6,970	9,090	18,000
At Western Corporate Limits	4.8	650	1,150	1,380	1,900
Blackburn Creek					
At Tehachapi Boulevard and Dennison Road	10.1	2,410	5,780	7,450	11,850
At Western Corporate Limits	16.2	2,730	6,970	9,090	18,000
Downstream of Tehachapi Boulevard	28.2	3,310	8,250	12,030	23,000
Near Highline Road	4.5	--	--	5,290	--
Blackwells Corner					
At State Highway 46	14.3	500	1,460	2,550	6,000
Bodfish Creek					

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
2,850 Feet above Confluence with Kern River	14.2	--	--	7,280	--
11,000 Feet above Confluence with Kern River	7.7	--	--	3,780	--
At Confluence with Kern River	16.8	--	--	8,530	--
Boron Avenue Creek					
At Confluence with Twenty Mule Team Creek	3.6	580	2,000	3,000	6,700
Breckenridge					
At Fairfax Road	14.0	520	1,200	1,600	2,900
Cache Creek					
At Downstream Limit of Study	163.4	1,900	5,300	7,800	16,400

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Caliente Creek					
Above Bealville Road Bridge	186.1	1,800	7,550	19,800	56,000
At State Highway 58	467.8	3,600	16,000	27,000	87,500
Caliente Creek Near Loraine					
Back Canyon Just Upstream of Confluence of Weaver Creek	20.0	325	1,800	3,350	12,300
Downstream of Indian Creek Confluence	124.0	1,650	9,050	16,900	61,000
Upstream of Sand Canyon Confluence	51.0	800	4,000	7,650	26,000
Upstream of Unnamed Tributary Confluence	47.0	770	3,800	7,100	24,000
Calvert Wash					
At Confluence With North El Paso Wash	12.8	--	--	1,425	--

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Cane, Chollo, and Short Canyon Creeks (Combined)					
At Kelso Creek Floodplain	21.55	--	--	3,800[1]	--
City of McFarland					
Basin 1	24.3	--	--	1,900	--
Basin 2	12.8	--	--	1,200	--
Basin 3	5.2	--	--	700	--
Basin 4	22.3	--	--	2,800	--
Basin 5	7.1	--	--	800	--
Basin 6	4.2	--	--	850	--
Claymine Wash					

[1] Represents 80 Percent Reduction in Flow

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
At State Highway 58	4.2	--	--	3,200	--
Cottonwood Creek					
At Mouth	51	500	3,750	7,800	34,000
Cuddy Creek					
At Lebec Road	46.4	850	3,900	7,750	25,000
Doyle Street					
At Beardsley Canal	2.7	--	--	650	--
East China Lake and College Heights Washes (Combined)					
At East Ridgecrest Boulevard	20.2	480	3,350	5,800	14,100
East Nicolls Peak					
At Apex of Alluvial Fan	1.0	140	820	1,540	5,480

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
El Paso Wash					
At North Downs Street and Ridgecrest-Inyoken Road	12.7	240	1,670	3,000	7,050
Erskine Creek					
At State Highway 179	37.7	850	2,300	7,700	25,000
Grapevine Canyon Creek	11.0	520	4,330	9,200	42,000
Great Circle Creek					
At Confluence with Yerba Rusche Creek	3.66	560	1,970	3,000	8,200
Hawthorne Boulevard					
At Union Avenue	3.0	310	680	1,050	1,950
Indian Creek					
At Confluence With Caliente Creek	58.0	1,200	5,750	10,200	34,000

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Indian Wells Canyon Creek	17.0	730	6,930	15,400	77,100
Jawbone Canyon Wash					
At Munsey Road	280.4	6,000	25,000	36,000	60,000
Kelso Creek					
At State Highway 178	159.5	2,850	11,000	22,700	68,000
Kern River					
At Gaging Station 5.8 Miles Northeast of Bakersfield Post Office	2,407.0	2,800	7,000	10,200	28,700
At Kernville Gaging Stations	1,009.0	13,400	44,000	69,000	186,000
At Stockdale Highway	--	2,800	7,000	10,200	28,700
Little Dixie Wash					
At Old Highway 395	215.0	9,000	19,500	27,000	53,600

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Flow Past Airport	--	--	--	6,000	--
Split Flow Through Inyokern	--	--	--	1,185	--
McFarland					
Along State Highway 99	4.2	--	--	2,550	--
North El Paso Wash					
Above Confluence With South El Paso Wash	6.9	--	--	2,000	--
North Ridgecrest Wash					
At Ridgecrest Corporate Limits	6.9	--	--	1,800	--
North Sandy Creek					
At Confluence with Sandy Creek	3.3	14	1,260	2,230	4,400

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Poso Creek					
At State Highway 58	368.0	2,900	11,500	19,000	52,000
Ridgecrest Wash					
At North China Lake Boulevard	10.8	230	1,600	2,700	6,750
Sand Canyon Creek	18.1	710	6,640	14,700	72,700
Sandy Creek					
At East End of Taft Airport	14.0	1,260	1,600	2,100	--
Just below Confluence with North Sandy Creek	20.2	1,274	2,980	4,440	--
Sheetflow At Mohave	20.0	--	--	13,300	--
Short Canyon Creek	4.8	350	2,610	5,300	22,600
South El Paso Wash					

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
At Ridgecrest Corporate Limits	12.7	--	--	3,000	--
South Fork Kern River					
Near Onyx	530	3,700	12,000	21,500	76,100
South Ridgecrest Wash					
At Las Flores Avenue	2.5	--	--	880	--
Tierra del Sol Creek					
At Confluence with Cache Creek	2.69	450	1,700	2,800	9,290
At North Loop Boulevard	1.96	445	1,680	2,765	9,175
At South Loop Boulevard	1.32	360	1,350	2,225	7,380
Twenty Mule Team Creek					
At AT&SF	44.1	--	--	7,300	--
Unnamed Tributary to Caliente Creek					

-- Data Not Available

Table 5 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
At Confluence With Caliente Creek	2.0	90	450	600	1,550
Upper Sycamore Creek					
At Lower End of Valley Road	14.9	260	990	2,900	10,000
Ward Street					
At Norris Road	5.9	--	--	1,300	--
Weaver Creek					
At Confluence With Caliente Creek	26.0	525	2,550	4,500	14,600
West China Lake Wash					
At East Ridgecrest Boulevard	1.8	70	500	860	2,100
Yerba Rusche Creek					
At Mendiburu Road	5.02	780	2,350	3,600	8,200

-- Data Not Available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were performed to provide estimates of the flood elevations of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables 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.

Cross sections were determined from topographic maps and field surveys. All bridges, dam, and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. 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 profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Roughness factors (Manning's "n"values) used in hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. A summary of the Manning's "n" values used for floodplain modeling of the streams studied in detail is shown in Table 6. The dimensions of structures that produce backwater were identified through field measurements. The dimensions of backwater-producing structures were identified through field measurements.

All qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First of Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the Firm with their 6-character NSRS Permanent Identifier.

- Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classifications. NSRS vary widely in vertical stability classifications. NSRS vertical stability classifications are as follows:
    - Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
    - Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)
    - Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument blow frost line)
    - Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM in the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

Kern County

Cross sections for the backwater analyses for most flooding sources in Kern County were obtained from aerial photographs at the negative scales of 1:2,400; 1:6,000 and 1:9,600. Cross sections used in the backwater computations for the stream sources in the Loraine, Mojave, and Inyokern areas were derived from photogrammetric compilation of aerial photographs, flown in November 1984 and January 1985 at a scale of 1:14,400 (Rick Engineering Company, January 1985). The below-water sections were obtained by field measurement. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Aerial reconnaissance (November 15, 1978) of the Kern River was supplied by the California DWR. Photographs were taken from 3,000 feet, with a negative scale of 1:6,000. Photogrammetric models were controlled (horizontally and vertically) by the California DWR.

For Blackburn and Antelope Creeks, channel and floodplain geometry was obtained using mapping developed by the NRCS. Photogrammetric models were field checked and controlled (vertically and horizontally) by field survey to third-order accuracy. Cross sections for the backwater analyses were obtained from NRCS data and supplemented by an existing map (U.S. Department of Agriculture, 1977, Mason, Vancuren and Wachob Civil Engineering, 1977, Cooper Aerial Survey, 1979 respectively). For Erskine Creek, cross sections for the backwater analysis were developed using a map at a scale of 1:2,400, with a contour interval of 2 feet (Aerial Photometrics, 1976).

Structural geometry of the Friant-Kern Canal and bridges near McFarland was obtained by the study contractor during field reconnaissance. Caliente and Inyokern bridges also were field surveyed (Rick Engineering Company, 1985).

In developing the flood risk data for the area east of the AT&SF Railway in the vicinity of the Mohave Airport, it was assumed that that flow paths for discharges originating from the alluvial fans to the west would be altered when they are intercepted by the railroad bed. The effect of this change in flow direction is that the flows tend to parallel the railroad in a swale along the western side of the railroad bed. Because the swale is too small to carry the total accumulated discharge, some flow will spill over the railroad bed and travel in an unpredictable manner toward the southeast.

The hydraulic modeling of this flood hazard was accomplished with the HEC-2 computer program (U.S. Department of the Army, Corps of Engineers, 1976). Because the flow paths are unpredictable and the flow depths average 1.0 foot, the area east of the railroad was designated Zone AO, Depth 1 foot. Although the elevations produced by the HEC-2

computer program were not shown on the FIRM, the velocities from that program are given below for use as a guide in managing development in this area. North of Highway 14, velocities range from 3 to 4.5 feet per second. South of Highway 14, velocities range from 5.5 through the shopping center to 2.5 feet per second above the Southern Pacific Railroad Grade. Through the Town of Mojave, flow velocities range from 3 to 6 feet per second.

For the study of the Caliente Creek (Loraine), Mojave, and Inyokern areas, starting water-surface elevations were based on approximate hydraulic computations using Manning's equation and existing studies where applicable.

Areas subject to alluvial fan flooding include Grapevine Canyon, Short Canyon, and Indian Wells Canyon. Topographic mapping at a scale of 1:1,000, with contour intervals of 5 and 20 feet, were used to determine alluvial fan boundaries.

The KCWA has identified Short, Cane, and Chollo Canyon Creeks, which are tributaries to Kelso Creek, as alluvial fans. The toes of these tributary fans are included in the analysis of the Kelso Creek floodplain. Alluvial fan depth, width, and velocity were computed using discharge probabilities from log-Pearson Type III analyses In accordance with U.S. Water Resources Council Bulletin 17A (U.S. Water Resources Council, 1977) and FEMA special flood hazard guidelines for alluvial fans (U.S. Department of Housing and Urban Development, no date).

In accordance with FEMA guidelines, the alluvial fan is characterized by unstable channel systems due to slope and soil conditions. Consequently, flows rarely spread evenly over the surface of an alluvial fan and can be concentrated in an identifiable temporary channel or confined to only portions of the fan surface. The ability of scour and deposit sediment makes flow paths prone to lateral migration and relocation to any portion of the fan during a single runoff event and subsequent events. This erratic, unpredictable behavior subjects all portions of the fan to potential flood hazard, regardless of location. As the fan widens, the probability of flooding at a given depth and velocity at a specific point, generally decreases.

Because the area east of China Lake Naval Weapons Center is undeveloped, the hydraulic analyses of the fans assumed unobstructed flow. U.S. Highway 395 and State Highway 14, although crossing the base of the fans perpendicularly, would not obstruct natural flows, because they are not elevated. There are several small culverts under U.S. Highway 395 that would convey nuisance water from the more frequent storms. During 1-percent annual chance peak flows, these would become silted and be considered ineffective.

Flows from Indian Wells Canyon are contained in a well-defined channel above State Highway 14. During the storm of 1945, flow broke through a dirt bank just upstream of State Highway 14 and flowed northerly. This bank has since been reinforced with large boulders and dirt.

The 1-percent annual chance flooding for the approximate-study reach of the Poso Creek split flow was estimated using normal-depth calculations. The flooding for the Kern River Flood Canal approximate study was based on a HEC-2 analysis prepared by the California DWR. The 1-percent annual chance flooding for other approximate studies was estimated using normal-depth calculations.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the streams studied by detailed methods were calculated using the slope-area method.

In the revisions within the unincorporated areas of Kern County, cross section data for the backwater analyses were obtained from topographic maps compiled from aerial photographs (Flood Boundary Map, no date). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Water-surface elevations of floods of the 1-percent annual chance recurrence interval were computed using the USACE HEC-2 step-backwater computer program (U.S. Department of the Army, 1973). The starting water-surface elevation for Bodfish Creek was determined using the slope area method.

Channel and overbank roughness factors (Manning's "n"values) used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the stream and floodplain areas. The channel "n" values for the Bodfish Creek ranged from 0.07 to 0.1, and the overbank "n" values ranged from 0.075 to 0.1.

The analysis of Bodfish Creek showed that at each road crossing the culvert capacity was inadequate, causing a portion of the flows to be diverted down the road. At Upper Bodfish Canyon Road about half of the total flow is diverted west along the road and through swales north and south of the road for a distance of about 1,400 feet, where it is intercepted by an unnamed tributary, which carries the overflow back to the main channel. The Lake Isabella Road crossing diverts some flow north along the road and through the commercial area northwest of Lake Isabella Road.

The hydraulic analysis of East Nicolls Peak was performed using the alluvial fan procedures adopted by FEMA (Flood Insurance Study, 1985). The apex of the fan is located 5,100 feet up-fan of Kelso Valley Road. The right side of the alluvial fan is defined by a wide shallow swale. Many of the possible flood paths across the fan enter the swale well above the toe of the fan (in the Kelso Creek floodplain). Thus the probability of a given flood inundating a given point within the swale is greater than the probability of that flood inundating a given point at the same elevation but not within the swale. The flooding analysis performed for East Nicolls Peak alluvial fan included the effects of the swale.

City of Bakersfield

In the City of Bakersfield, 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. Water-surface elevations of floods of the selected recurrence intervals on Cottonwood Creek and the 10-, 2-, and 1-percent annual chance floods on the Kern River were computed through use of the USACE HEC-2 step-backwater computer program (U.S. Department of the Army, Corps of Engineers, December 1968 with updates).

The California DWR, Reclamation Board, provided the cross-section information used for the backwater analysis along the Kern River. These cross sections were digitized from aerial photographs flown in April 1977 at a flight height of 6,000 feet, with a negative scale of 1:12,000 (1K. Curtis Services, Inc., Aerial Photography, Scale 1:12,000, April

1977). Additional cross sections and modifications to those supplied by the California DWR were taken from topographic maps (U.S. Dept. of the Interior, Geological Survey,1968; California DWR, 1976; and California DWR, 1979), levee plans (Rickett, Ward, and Del Marter, Plan, Profile, and Cross Section Data, September 1981), diversion structure plans (City of Bakersfield, California, Department of Water Resources, Kern River Canal Diversion Structure Plans, Stetson Engineers, Inc.), and bridge plans (Kern County, California, Department of Highways and Bridges, January 1980).

Cross sections for the backwater analysis of Cottonwood Creek were digitized from aerial photographs flown in October 1979, at a flight height of 4,800 feet, with a negative scale of 1:9,600 (Cooper Aerial Survey, Aerial Photography, Scale 1:9,600, October 1979). Structural geometry was obtained by the study contractor during field reconnaissance.

Due to the large size of the openings and the height of the low chord elevation of the State Highway 178 (Lake Isabella Freeway) bridge on Cottonwood Creek, the HEC-2 bridge routine was not used to model this structure. Instead, the Manning's coefficient was increased to 0.065 in the channel to reflect the obstruction by piers.

Starting water-surface elevations for the Kern River and Cottonwood Creek were calculated using the slope-area method. Water-surface elevations of the 0.2-percent annual chance flood on the Kern River were determined by the USACE (U.S. Department of the Army, Corps of Engineers, October 1969). No new analysis for this flood frequency was performed by the study contractor.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Generally, the distances on the flood profiles correspond to distances measured along the centerline of the designated watercourses. In several areas, however, the meandering nature of the low flow streambeds necessitated use of distances measured along the centerline of the 1-percent annual chance flow paths. These flow lines, which are used to establish the respective profile distances, are delineated and labeled as Profile Base Lines on the maps.

Since portions of the left and right overbank levees along the Kern River just upstream of Stockdale Highway are not considered to provide effective 1-percent annual chance flood protection due to lack of 3-foot freeboard, an additional hydraulic analysis was performed removing the levee from the analysis. Elevations for the 10-, 2-, and 1- percent annual chance floods were developed using the USACE HEC-2 step-backwater computer program (U.S. Department of the Army, Corps of Engineers, December 1968 with updates).

Profiles labeled "Kern River-With Consideration of Levees" represent elevations that would occur if flooding was contained by the levees. The extent of these profiles includes flood elevations upstream of the leveed area. Profiles labeled "Kern River-Without Consideration of Levees" represent elevations that would occur by ignoring the existence of the levees. These profiles extend from the downstream to upstream limits of the levees having less than 3 feet of freeboard.

Flooding in the Hawthorne Ravine-Wilshire Heights area was analyzed by normal-depth calculations. This analysis showed that the 1-percent annual chance flood would cause widespread but shallow flooding with average flood depths of less than 1 foot.

City of California City

For the City of California City, flooding from Cache and Tierra del Sol Creeks was evaluated for the 10-, 2-, 1-, and 0.2-percent annual chance events. Water-surface elevations were calculated using the USACE HEC-2 step-backwater computer program (U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, December 1968, with updates). Flooding in overbank areas downstream of the confluence of Yerba Rusche and Great Circle Creeks was also analyzed using the HEC-2 program. Upstream of the confluence, normal-depth calculations were used.

For all flooding sources, channel and flood plain geometry was obtained using aerial photogrammetry. Aerial surveys for this study were performed by Cooper Aerial Survey Company on May 22, 1979 (Cooper Aerial Survey Company, September 1979, unpublished). Photos were taken from an altitude of 4,800 feet, with a scale of 1:9,600. Photogrammetric models were horizontally and vertically controlled by the study contractor in accordance with FIS guidelines and specifications. Digitized cross sections, accurate to within 1 foot, were provided by Cooper Aerial Survey Company. Starting water-surface elevations for each stream studied by detailed analyses were obtained using the slope-area method.

In the area of Yerba Rusche and Great Circle Creeks, average 1-percent annual chance flood depths were established in accordance with shallow flooding guidelines using the HEC-2 program and normal-depth calculations. The flooding in this area is designated shallow flooding with flood depths averaging less than 1.0 foot.

Normal-depth calculations show the capacity of Yerba Rusche Creek to be approximately 600 cfs. This is much less than the 1-percent annual chance discharge of 3,600 cfs downstream of the confluence with Great Circle Creek. In addition, Yerba Rusche and Great Circle Creeks do not follow the natural drainage; therefore, a somewhat different hydraulic analysis was used for these creeks.

It was determined that once Yerba Rusche Creek was filled to capacity, additional water would flow overland, following the natural topography. Thus, shallow flooding for areas downstream of the confluence with Great Circle Creek is based on a 3,600 cfs discharge, with 600 cfs in the channel and 3,000 cfs flowing overland. Upstream of the confluence, average flood depths were calculated for a 600 cfs discharge in Yerba Rusche Creek, with 3,000 cfs flowing overland toward Great Circle Creek.

Because Yerba Rusche and Great Circle Creeks will be flowing full during major flood events, such as the 10-percent annual chance or greater, the channels should not be encroached upon. Normal-depth calculations were used in determining channel capacity.

City of McFarland

In the City of McFarland, water-surface elevations were calculated using normal-depth calculations and the USACE HEC-2 step-backwater computer program (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1973).

Channel and flood plain geometry was obtained using aerial photogrammetry. Aerial reconnaissance for this study was performed by the Cooper Aerial Survey Company in November 1981. Photos were taken from a height of 4,800 feet, with a negative scale of

1:9,600. Photogrammetric models were controlled (horizontally and vertically) by the study contractor. Digitized cross sections, accurate to within 1 foot, were provided by the Cooper Aerial Survey Company. Topographic mapping was compiled at a scale of 1:4,800, with a 4-foot contour interval (Cooper Aerial Survey Company, November 1981).

Structural geometry of the canal and bridges was obtained by the study contractor during field reconnaissance and verified by additional Arrow Surveying field measurements.

City of Ridgecrest

For all detailed flooding sources in the City of Ridgecrest, channel and flood plain geometry was obtained using aerial photogrammetry (Cooper Aerial Survey Company, May 22, 1979). Digitized cross sections, accurate to within 1 foot, were obtained from aerial photographs (Cooper Aerial Survey Company, May 22, 1979).

Flooding from El Paso Wash was evaluated for the 10-, 2-, 1-, and 0.2-percent annual chance events along the reach between Ridgecrest-Inyokern Road and the China Lake spur track. The other flooding sources were only evaluated for the 1-percent annual chance event, because flooding depths were less than 3 feet.

Water-surface elevations were calculated using the USACE HEC-2 step-backwater computer program (U.S. Department of the Army, Corps of Engineers, December 1968, With Updates). Averages depths of flooding were obtained from normal-depth calculations.

Dimensions of significant bridges and culverts were obtained from field measurements taken during field reconnaissance in June 1979. Water-surface elevations for the referenced events are shown on the flood profiles for El Paso Wash. No profiles are plotted for shallow flooding areas. Starting water-surface elevations for backwater analysis were obtained using the slope-area method. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The results of the analysis showed that Ridgecrest is generally subject to shallow flooding of less than 1 foot. The City of Ridgecrest requires all new development to be elevated at least 1 foot above the curb elevation. Therefore, it was decided that these shallow flooding areas would be Zone X.

City of Shafter

In the City of Shafter, ground elevations at street intersections in the study area were obtained by surveys performed in February 1987 (Surveys by Gill and Pulver Engineers, February 1988).

Flooding in the Walker Street detailed study region, north of Lerdo Highway and east of Shafter Avenue, is ponding due to inadequate local drainage facilities. The recently completed drainage system involves an increased capacity in the drop inlets and the culverts draining the intersection of Kannel Avenue and Lerdo Highway, and the construction of a second drainage sump (66 acre-feet) downslope of the existing drainage slope. In order to determine the depth of flooding at the lower end of the Walker Street

detailed study area at the Mannel Avenue and Lerdo Highway intersection, and to determine the adequacy of the two sumps, the 1-percent annual chance flood hydrograph was routed through the system using hand computations. The hydraulic rating of the culverts and sumps was determined using the design specifications in the Shafter Drainage Study (Ricks, Taylor & Meyer, Inc., no date. and Ricks, Taylor & Meyer, Inc., Shafter Drainage Study, Volume II, 25 Year Hydrology, no date). Due to the slow drainage of the Terminal Sump (Telephone conversation, John Quinn and Rodney Lutz, February 18, 1988) and the possibility of a storm or series of storms prior to the 1-percent annual chance flood event, it was assumed that the Terminal Sump was half full at the start of the 1-percent annual chance event.

The routing of the 1-percent annual chance flood hydrograph indicated that both the Hudson Park Detention Basin and Terminal Sump would fill and spill during a 1-percent annual chance event. The flooding elevation at the intersection of Mannel Avenue and Lerdo Highway exceeded the elevation of the crest elevation of Lerdo Highway, and caused weir flow south of Lerdo Highway out of the city corporate limits.

City of Taft

The analyses of the hydraulic characteristics of flooding from the sources studied in the City of Taft were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

For Sandy Creek and North Sandy Creek, channel and floodplain geometry were obtained using mapping developed by aerial photogrammetry. Digitized cross sections were generated from aerial reconnaissance (Cooper Aerial Survey, Topographic Maps, June 2, 1979). Photographs were taken from 4,800 feet, with a negative scale of 1:9,600. Photogrammetric models were controlled (horizontally and vertically) by the study contractor to third-order accuracy. Water-surface elevations for the selected recurrence intervals were computed using the USACE HEC-2 computer program (U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, 1976). Starting water-surface elevations were calculated using the slope-area method. The 1-percent annual chance flooding for approximate studies in the south of Taft was estimated using normal-depth calculations.

City of Tehachapi

The analyses of the hydraulic characteristics of the flooding sources studied in the City of Tehachapi were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

The water-surface elevations for Antelope and Blackburn Creeks were computed through use of the USACE HEC-2 step-backwater computer program (U.S. Department of the Army, Corps of Engineers, December 1968, with updates). The source of much of the input data was the NRCS Tehachapi Watershed Study (U.S. Department of Agriculture, Soil Conservation Service, 1977).

For all flooding sources, channel and flood plain geometry was obtained using aerial photogrammetry (Mason, Vancuren and Wacob Civil Engineering, Compiled 1977, unpublished). Photogramnetric models were controlled (vertically and horizontally) by field survey to third-order accuracy and field checked. Cross sections for the backwater

analyses were obtained from NRCS data and supplemented by an existing map having a 5-foot contour interval (Mason, Vancuren and Wacob Civil Engineering, Compiled 1977, unpublished). Structures affecting the hydraulic computations were field checked to obtain pertinent dimensions. Starting water-surface elevations were calculated using the slope-area method. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The approximate study area to the north of State Highway 58 was studied using normal-depth calculations. The remaining approximate study area and the shallow flooding areas were studied using the USACE HEC-2 step-backwater computer program (U.S. Department of the Army, Corps of Engineers, December 1968, With Updates). Shallow flooding areas were verified using normal depth calculations.

City of Wasco

The analyses of the hydraulic characteristics of flooding from the sources studied for the City of Wasco were carried out to provide estimates of the elevations for the 1-percent annual chance flood. Cross sections of the study area were surveyed in October 1987 (Quad Engineering, Inc., Cross Section Survey, Field Notes, October 1987).

Water-surface elevations in the ponding area were determined from the volume of runoff resulting from the hydrologic analyses. Elevation information for State Highway 46 and State Highway 43 was obtained from California Department of Transportation highway drawings (California Department of Transportation, State Highway 46 [1930] and State Highway 43 [1947] Plan and Profile Drawings) to confirm flood limits on the north end of the flooding area.

Table 6, "Manning's "n" Values," contains a summary of Manning's "n" values used in this countywide FIS study.

Table 6 – MANNING'S "N" VALUES

Stream	Left Overbank "n"	Channel "n"	Right Overbank "n"
Antelope Creek	0.060 - 0.090	0.025 - 0.050	0.060 - 0.090
Blackburn Creek	0.030 - 0.090	0.025 - 0.050	0.030 - 0.090
Blackwells Corner	0.040 - 0.045	0.040	0.040 - 0.045
Bodfish Creek	0.075 - 0.1	0.070 - 0.1	0.075 - 0.1
Boron Avenue Creek	0.030 - 0.085	0.025 - 0.049	0.030 - 0.085
Breckenridge	0.040 - 0.050	0.040 - 0.050	0.040 - 0.050
Cache Creek	0.055 - 0.070	0.050 - 0.060	0.055 - 0.070

Table 6 – MANNING'S "N" VALUES

Stream	Left Overbank "n"	Channel "n"	Right Overbank "n"
Caliente Creek	0.025 - 0.059	0.024 - 0.060	0.025 - 0.059
Caliente Creek near Loraine	0.020 - 0.045	0.020 - 0.040	0.020 - 0.045
Caliente Creek Tributary 1	0.020 - 0.045	0.020 - 0.040	0.020 - 0.045
Calvert Wash	0.040	0.030	0.040
Claymine Road	0.025 - 0.070	0.025 - 0.070	0.025 - 0.070
Cottonwood Creek	0.055 - 0.06	0.045	0.055 - 0.06
Cuddy Creek	0.035 - 0.050	0.030 - 0.045	0.035 - 0.050
Doyle Street	0.010 - 0.060	0.010 - 0.060	0.010 - 0.060
East China Lake and College	0.040 - 0.055	0.030 - 0.055	0.040 - 0.055
El Paso Wash	0.040 - 0.055	0.03 - 0.055	0.040 - 0.055
Erskine Creek	0.035 - 0.070	0.035 - 0.070	0.035 - 0.070
Great Circle Creeks	0.065 - 0.090	0.050 - 0.060	0.065 - 0.090
Hawthorne	0.012 - 0.046	0.012 - 0.046	0.012 - 0.046
Jawbone Canyon Wash	0.045	0.030 - 0.045	0.045
Kelso Creek	0.035 - 0.050	0.035 - 0.050	0.035 - 0.050
Kern River at Kernville	0.040 - 0.065	0.036 - 0.041	0.040 - 0.065
Kern River – with consideration of Levees	0.035 - 0.065	0.030 - 0.065	0.035 - 0.065
Kern River – without consideration of Levees	0.035 - 0.065	0.030 - 0.065	0.035 - 0.065
Little Dixie Wash (Lower Reach)	0.025 - 0.045	0.025 - 0.035	0.025 - 0.045
McFarland East of State Highway 99	0.025 - 0.045	0.025 - 0.030	0.025 - 0.045

Table 6 – MANNING'S "N" VALUES

Stream	Left Overbank "n"	Channel "n"	Right Overbank "n"
North El Poso Wash	0.040 - 0.045	0.030 - 0.035	0.040 - 0.045
North Ridgecrest Wash	0.040	0.030	0.040
North Sandy Creek	0.024 - 0.045	0.024 - 0.040	0.024 - 0.045
Poso Creek	0.030 - 0.035	0.025	0.030 - 0.035
Ranger Station Creek	0.055 - 0.059	0.030 - 0.033	0.055 - 0.059
Ridgecrest Wash	0.040 - 0.055	0.030 - 0.055	0.040 - 0.055
Sandy Creek	0.024 - 0.045	0.024 - 0.040	0.024 - 0.045
Sheetflow At Mohave	0.035 - 0.050	0.025 - 0.050	0.035 - 0.050
South El Poso Wash	0.040 - 0.045	0.030 - 0.035	0.040 - 0.045
South Fork Kern River	0.042 - 0.062	0.032 - 0.055	0.042 - 0.062
South Ridgcrest Wash	0.040	0.030	0.040
Tierra del Sol Creek	0.055 - 0.070	0.050 - 0.060	0.055 - 0.070
Twenty Mule Team Creek	0.016 - 0.075	0.013 - 0.075	0.016 - 0.075
Upper Sycamore Creek	0.024 - 0.042	0.020 - 0.042	0.024 - 0.042
Ward Street	0.025 - 0.045	0.025 - 0.030	0.025 - 0.045
West China Lake Wash	0.040 - 0.055	0.030 - 0.055	0.040 - 0.055
Yerba Rusche Creek	0.065 - 0.090	0.050 - 0.060	0.065 - 0.090

The conversion factor for each stream studied by detailed methods is shown below in Table 7, "Stream Conversion Factors".

Table 7 - STREAM CONVERSION FACTORS

Stream Name	Elevation (feet NAVD above NGVD)
20 Mule Team Creek	2.6
Antelope Creek	2.8
Blackburn Creek	2.8
Bodfish Creek	3.2
Boron Avenue Creek	2.6
Cache Creek	2.7
Caliente Creek	2.7
Caliente Creek near Loraine	2.9
Caliente Creek Tributary 1	2.9
Calvert Wash	2.7
Cottonwood Creek	2.8
Cuddy Creek	3.1
El Paso Wash	2.7
Erskine Creek	3.2
Indian Creek	2.9
Jawbone Canyon Wash	2.6
Kern River at Kernville	3.3
Kern River – with consideration of Levees	2.7
Kern River – without consideration of Levees	2.7
Little Dixie Wash	2.7
North El Paso Wash	2.7
North Ridgecrest Wash	2.7
North Sandy Creek	2.7
Poso Creek	2.7
Ranger Station Creek	3.2
Sandy Creek	2.7
Sheet Flow 1	2.7
Sheet Flow 2	2.7
Sheet Flow 3	2.7
South Branch Poso Creek	2.7
South El Paso Wash	2.7
South Fork Kern River	3.1

Table 7 - STREAM CONVERSION FACTORS

Stream Name	Elevation (feet NAVD above NGVD)
South Ridgecrest Wash	2.7
Tierra Del Sol Creek	2.7
Upper Sycamore Creek	2.9
Weaver Creek	2.9

Levee Hazard Analysis

Some flood hazard information presented in prior FIRMs and in prior FIS reports for Churchill County and its incorporated communities was based on flood protection provided by levees. Based on the information available and the mapping standards of the National Flood Insurance Program at the time that the prior FISs and FIRMs were prepared, FEMA accredited the levees as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year. For FEMA to continue to accredit the identified levees with providing protection from the base flood, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

On August 22, 2005, FEMA issued *Procedure Memorandum No. 34 - Interim Guidance for Studies Including Levees*. The purpose of the memorandum was to help clarify the responsibility of community officials or other parties seeking recognition of a levee by providing information identified during a study/mapping project. Often, documentation regarding levee design, accreditation, and the impacts on flood hazard mapping is outdated or missing altogether. To remedy this, *Procedure Memorandum No. 34* provides interim guidance on procedures to minimize delays in near-term studies/mapping projects, to help our mapping partners properly assess how to handle levee mapping issues.

While 44 CFR Section 65.10 documentation is being compiled, the release of more up-to-date FIRM panels for other parts of a community or county may be delayed. To minimize the impact of the levee recognition and certification process, FEMA issued *Procedure Memorandum No. 43 - Guidelines for Identifying Provisionally Accredited Levees* on March 16, 2007. These guidelines will allow issuance of preliminary and effective versions of FIRMs while the levee owners or communities are compiling the full documentation required to show compliance with 44 CFR Section 65.10. The guidelines also explain that preliminary FIRMs can be issued while providing the communities and levee owners with a specified timeframe to correct any maintenance deficiencies associated with a levee and to show compliance with 44 CFR Section 65.10.

FEMA contacted the communities within Churchill County to obtain data required under 44 CFR 65.10 to continue to show the levees as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year.

FEMA understood that it may take time to acquire and/or assemble the documentation necessary to fully comply with 44 CFR 65.10. Therefore, FEMA put forth a process to provide the communities with additional time to submit all the necessary documentation. For a community to avail itself of the additional time, it had to sign an agreement with

FEMA. Levees for which such agreements were signed are shown on the final effective FIRM as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year and labeled as a Provisionally Accredited Levee (PAL). Communities have two years from the date of FEMA's initial coordination to submit to FEMA final accreditation data for all PALs. Following receipt of final accreditation data, FEMA will revise the FIS and FIRM as warranted.

FEMA coordinated with the U.S. Army Corps of Engineers, the local communities, and other organizations to compile a list of levees that exist within Churchill County. Table 8, "List of Levees Requiring Flood Hazard Revisions" lists all levees shown on the FIRM, to include PALs, for which corresponding flood hazard revisions were made.

Approximate analyses of "behind levee" flooding were conducted for all the levees in Table 8 to indicate the extent of the "behind levee" floodplains. The methodology used in these analyses is discussed below.

The approximate levee analysis was conducted using information from existing hydraulic models (where applicable) and USGS topographic maps.

The extent of the 1-percent-annual-chance flood in the event of levee failure was determined. Base flood elevations and topographic information (where available) were used to estimate an approximate 1-percent-annual-chance floodplain and traced along the contour line representing the base flood elevation. If base flood elevations were not available they were estimated from effective FIRM maps and available information. Topographic features such as highways, railroads, and high ground were used to refine approximate floodplain boundary limits.

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
City of Bakersfield Kern County	Kern River	1	(-119.259, 35.304) (-119.257, 35.307)	06029C2250E	No
City of Bakersfield	Kern River	2	(-119.259, 35.301) (-119.253, 35.303)	06029C2250E	No
City of Bakersfield Kern County	Kern River	3	(-119.247, 35.305) (-119.151, 35.335)	06029C2275E	No
City of Bakersfield	Rio Bravo Canal	5	(-119.133, 35.357) (-119.130, 35.354)	06029C2257E	No
City of Bakersfield Kern County	Kern River	7	(-119.185, 35.347) (-119.048, 35.378)	06029C1818E 06029C2257E 06029C2275E 06029C2276E 06029C2277E 06029C2281E	No
City of Bakersfield	Kern River	8	(-119.131, 35.351) (-119.102, 35.355)	06029C2257E 06029C2276E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
City of Bakersfield	Kern River	9	(-119.104, 35.354) (-119.091, 35.362)	06029C2276E 06029C2277E	No
City of Bakersfield	Kern River	10	(-119.088, 35.362) (-119.080, 35.361)	06029C2277E	No
City of Bakersfield	Kern River	13	(-119.066, 35.365) (-119.058, 35.370)	06029C2277E 06029C2281E	No
City of Bakersfield	Kern River	14	(-119.056, 35.369) (-119.054, 35.371)	06029C2281E	No
City of Bakersfield	Kern River	15	(-119.053, 35.372) (-119.050, 35.374)	06029C2281E	No
Kern County	Undetermined	16	(-119.546, 35.391) (-119.542, 35.389)	06029C1725E	No
City of Bakersfield	Kern River	18	(-119.044, 35.379) (-119.040, 35.381)	06029C1818E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
City of Bakersfield[1] Kern County[1]	Undetermined	20	(-118.879, 35.292) (-118.949, 35.304)	06029C2325E	No
Kern County	Undetermined	21	(-119.662, 35.731) (-119.659, 35.718)	06029C0650E	No
Kern County	Undetermined	24	(-119.658, 35.718) (-119.653, 35.718)	06029C0650E	No
Kern County	Undetermined	25	(-119.657, 35.717) (-119.642, 35.717)	06029C0650E	No
Kern County[2]	Undetermined	28	(-117.856, 35.794) (-117.852, 35.780)	06029C0500E	No
Kern County[3]	Undetermined	29	(-120.081, 35.672) (-120.070, 35.680)	06029C0575E	No
City of Delano[3] City of McFarland[3] Kern County[3]	Undetermined	30	(-119.242, 35.741) (-119.208, 35.592)	06029C0740E 06029C0750E 06029C1277E 06029C1279E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
City of Delano[2] City of McFarland[2] Kern County[2]	Undetermined	31	(-119.238, 35.735) (-119.208, 35.595)	06029C0740E 06029C0750E 06029C1277E 06029C1279E	No
Kern County[3]	Undetermined	32	(-117.801, 35.652) (-117.787, 35.635)	06029C1018E	No
Kern County[1]	Undetermined	33	(-119.362, 35.313) (-119.323, 35.311)	06029C2250E	No
Kern County[1]	Undetermined	34	(-119.337, 35.293) (-119.318, 35.275)	06029C2250E	No
Kern County	Undetermined	35	(-119.337, 35.294) (-119.284, 35.296)	06029C2250E	No
Kern County	Kern River	36	(-119.318, 35.276) (-119.283, 35.295)	06029C2250E	No
Kern County[1]	Kern River	37	(-119.275, 35.311) (-119.256, 35.307)	06029C2250E	No
Kern County[3]	Undetermined	41	(-119.304, 35.210) (-119.250, 35.209)	06029C2675E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
Kern County[3]	Undetermined	43	(-119.002, 35.165) (-118.995, 35.145)	06029C2725E 06029C2750E	No
Kern County[2]	Undetermined	44	(-119.362, 35.063) (-119.359, 35.060)	06029C3075E	No
Kern County	Undetermined	45	(-119.295, 35.145) (-119.241, 35.151)	06029C2675E 06029C2700E	No
Kern County[4]	Undetermined	48	(-119.324, 35.088) (-119.308, 35.087)	06029C3075E	No
Kern County[4]	Undetermined	49	(-119.294, 35.085) (-119.278, 35.082)	06029C3075E	No
Kern County[4]	Undetermined	50	(-119.251, 35.073) (-119.206, 35.075)	06029C3075E 06029C3100E	No
Kern County[4]	San Emigdio Creek	51	(-119.190, 35.075) (-119.156, 35.072)	06029C3100E	No
Kern County[4]	Undetermined	52	(-119.139, 35.068) (-119.134, 35.066)	06029C3100E	No
Kern County[4]	Undetermined	53	(-119.120, 35.066) (-119.107, 35.064)	06029C3125E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
Kern County[4]	Undetermined	54	(-119.074, 35.048) (-119.070, 35.046)	06029C3125E	No
Kern County[3]	Tecuya Creek	55	(-118.979, 35.090) (-118.957, 35.025)	06029C3150E	No
Kern County[3]	Undetermined	56	(-118.159, 35.125) (-118.146, 35.115)	06029C3285E	No
Kern County[2]	Undetermined	57	(-118.144, 35.025) (-118.124, 35.010)	06029C3295E	No
Kern County[4]	Salt Creek	58	(-118.976, 34.983) (-118.967, 34.980)	06029C3525E	No
Kern County[4]	Tecuya Creek	59	(-118.959, 34.977) (-118.952, 34.975)	06029C3525E	No
Kern County[4]	Grapevine Creek	60	(-118.927, 34.969) (-118.908, 34.962)	06029C3525E	No
City of California City[3]	Undetermined	61	(-117.805, 35.229) (-117.792, 35.236)	06029C2960E	No
Kern County	Undetermined	64	(-119.352, 35.210) (-119.305, 35.210)	06029C2675E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
Kern County[1]	Undetermined	81	(-119.173, 35.159) (-119.168, 35.159)	06029C2700E	No
Kern County[1]	Undetermined	82	(-119.212, 35.634) (-119.197, 35.690)	06029C0225E 06029C0740E 06029C0750E	No
Kern County[1]	Undetermined	95	(-119.299, 35.253) (-119.290, 35.235)	06029C2250E 06029C2675E	No
City of Bakersfield	Kern River	99	(-119.070, 35.365) (-119.069, 35.364)	06029C2277E	No
City of Bakersfield	Kern River	100	(-119.078, 35.363) (-119.072, 36.364)	06029C2277E	No
Kern County[4]	Oak Creek	103	(-118.290, 34.989) (-118.286, 34.991)	06029C3650E	No
Kern County[1]	Undetermined	109	(-119.622, 35.683) (-119.619, 35.646)	06029C0675E	No
Kern County	Kern River	114	(-119.315, 35.274) (-119.307, 35.271)	06029C2250E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
Kern County	Undetermined	115	(-119.297, 35.268) (-119.279, 35.268)	06029C2250E	No
Kern County[4]	Undetermined	117	(-119.294, 35.085) (-119.268, 35.078)	06029C3075E	No
Kern County[1]	Undetermined	119	(-119.303, 35.240) (-119.301, 35.251)	06029C2250E 06029C2675E	No
Kern County	Undetermined	122	(-119.593, 35.422) (-119.578, 35.419)	06029C1725E	No
Kern County[1]	Undetermined	126	(-119.640, 35.596) (-119.626, 35.533)	06029C1200E	No
Kern County[1]	Poso Creek	132	(-119.237, 35.613) (-119.240, 35.602)	06029C1280E	No
Kern County[1]	Undetermined	142	(-119.253, 35.209) (-119.235, 35.209)	06029C2675E 06029C2700E	No
Kern County[1]	Undetermined	159	(-119.640, 35.600) (-119.627, 35.533)	06029C1200E	No
Kern County	Kern River	200	(-119.164, 35.340) (-119.146, 35.340)	06029C2275E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
City of Bakersfield Kern County	Kern River	201	(-119.141, 35.340) (-119.141, 35.347)	06029C2257E 06029C2275E	No
Kern County[2]	Undetermined	205	(-119.229, 35.466) (-119.205, 35.447)	06029C1800E	No
Kern County[2]	Undetermined	207	(-118.936, 35.364) (-118.890, 35.353)	06029C2306E 06029C2307E	No
Kern County[3]	Undetermined	211	(-118.788, 35.206) (-118.788, 35.200)	06029C2775E	No
Kern County[3]	Undetermined	220	(-118.783, 35.213) (-118.783, 35.210)	06029C2775E	No
Kern County[3]	Undetermined	221	(-118.783, 35.209) (-118.777, 35.209)	06029C2775E	No
Kern County[3]	Undetermined	222	(-118.788, 35.200) (-118.780, 35.200)	06029C2775E	No
City of California City[3]	Undetermined	301	(-117.824, 35.216) (-117.820, 35.219)	06029C2955E	No
City of California City[3]	Undetermined	401	(-117.726, 35.206) (-117.725, 35.206)	06029C2980E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

Table 8 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinate Latitude/Longitude	FIRM Panel	USACE Levee
Kern County[3]	Undetermined	402	(-117.779, 35.411) (-117.763, 35.410)	06029C2075E	No
Kern County[3]	South El Paso Wash	403	(-117.757, 35.602) (-117.755, 35.599)	06029C1557E	No
Kern County[3]	Undetermined	404	(-119.063, 35.708) (-119.063, 35.708)	06029C0775E	No

[1] Canal
[2] Railroad
[3] Road
[4] Aqueduct
[5] Dike

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 in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the finalization of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are being prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD. Structure and ground elevations in the community must, therefore, be referenced to NAVD. It is important to note that adjacent communities may be referenced to NGVD. This may result in differences in Base (1-percent annual chance) Flood Elevations (BFEs) across the corporate limits between the communities.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD and NAVD, 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/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Springs, MD 20910-3282
(301) 713-3242

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 (TSDN) associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these 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 provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1-percent annual chance and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS 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 (1-percent annual chance) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

For the flooding sources studied by approximate methods, the boundaries of the 1-percent annual chance floodplains were delineated using topographic maps taken from the previously printed FIS reports, FHBMs, and/or FIRMS for all of the incorporated and unincorporated jurisdictions within Kern County. For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM.

The 1-and 0.2-percent annual chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and AH), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-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 because of limitations of the map scale and/or lack of detailed topographic data.

Kern County

In Kern County the boundaries between cross sections were interpolated using topographic maps at scales of 1:2,400, 1:4,800 and 1:6,000, with contour intervals of 2, 4, 5, and 20 feet (U.S. Department of Agriculture, 1977, Mason, Vancuren and Wachob Civil Engineering, 1977, Cooper Aerial Survey, 1979, Aerial Photometrics, 1976 and U.S. Department of the Interior,1972).The floodplain boundaries for the lower reach of Caliente Creek were determined by the KCWA (Kern County Water Agency, 1973).

The alluvial fan boundaries for Grapevine, Short, and Indian Wells Canyon Creeks were delineated using topographic maps enlarged to a scale of 1:12,000, with a contour interval of 20 feet (U.S. Department of the Interior, 1972).

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown. The boundaries were delineated using topographic maps at a scale of 1:24,000, with contour intervals of 5, 10, 20, 40, and 50 feet (U.S. Department of the Interior, numerous dates). Approximate 1-percent annual chance floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map for Kern County (U.S. Department of Housing and Urban Development, 1978).

Approximate boundaries of the flooding just south of Mojave were determined using computed depths and topographic maps (Rick Engineering Company, 1985).

The revision of unincorporated areas of Kern County includes the study of Bodfish Creek and East Nicolls Peak alluvial fan. It was incorporated in this Section in 1989 to update the September 26, 1986, Kern County FIS. According to these revisions, for the stream studied in detail, Bodfish Creek and the East Nicolls Peak Alluvial Fan, flood boundaries were delineated using topographic maps at a scale of 1:4,800 with a contour interval of 4 feet (U.S. Department of the Army, 1973).

The 1-percent annual chance flood limits of Bodfish Creek were delineated based on the water-surface elevations computed by HEC-2. In a few instances the boundary was widened to incorporate areas which have experienced shallow flooding in the past. This is the case west of Lake Isabella Road and along Bodfish Canyon Road south of the lower culvert crossing.

Another revision of this study was completed on March 2, 1994, to provide flood hazard information based on new analyses of flooding on Freeman Gulch, Grapevine Canyon, Indian Wells Canyon, Sand Canyon, Short Canyon, and Short Canyon at Kelso Creek.

In the revision, the areas subject to alluvial fan flooding were delineated based-on-field investigations and topographic mapping at a scale of 1:24,000 with contour intervals of 10 and 20 feet. The FEMA methodology for analyzing flood risks in areas subject to alluvial fan flooding was used to determine depths and velocities. For Indian Wells Canyon, the magnitude of flow at which water will leave the main channel at a point approximately 2,800 feet upstream of Highway 14, and at which water from the main channel will overtop ridges beginning at Highway 14, was considered in determining the limits of 1-percent annual chance flooding.

Areas subject to alluvial fan flooding where the 1-percent annual chance flood depth is, on average, less than 1.0 foot, are labeled Shaded Zone X. When realized, the hazards associated with alluvial fan flooding are just as severe in areas designated Shaded Zone X as those designated Zone A or Zone AO. The distinction between the zones should be regarded as a distinction between flooding potentials and not a distinction between the severity of damages to be expected in the event of a flood.

The topography of the right overbank area for a portion of the reach of Kelso Creek referred to above has changed substantially since it was studied by detailed methods and shown on the previous FIRM. That change resulted from alluvial fan flooding originating in Short Canyon in August 1984. Because the detailed hydraulic model of Kelso Creek depends, in part, on that topography, the Flood Insurance Zone designation for that reach has been revised to Zone A. Zone A is used to designate areas inundated by the 1-percent annual chance flood, determined by approximate methods. Base flood elevations and floodways are not shown in areas designated Zone A.

It should be noted, however, that the floodway concept applies in most areas designated Zone A and, in particular, applies to the Kelso Creek floodplain. Because a floodway was previously designated for Kelso Creek, sound floodplain management indicates that, at a minimum, encroachments be prohibited in areas within the Kelso Creek floodplain that were previously designated part of the floodway unless it has been demonstrated that the proposed encroachment would not result in any increase in flood levels during the occurrence of the base flood discharge. In addition, care must be taken that encroachments outside of the previously shown floodway do not result in an increase of more than 1.0 foot during such an occurrence.

City of Bakersfield

For the Kern River in the City of Bakersfield, boundaries of the 1-percent annual chance flood have been delineated using topographic maps at a scale of 1:2,400 with contour intervals of 5 and 2 feet (California Department of Water Resources, Topographic Maps, 1976 and 14). For Cottonwood Creek, boundaries of the 1- and 0.2-percent annual chance floods have been delineated using topographic maps at a scale of 1:4,800 with a contour interval of 4 feet (Cooper Aerial Survey, Topographic Maps, Scale 1:4,800, Contour Interval 4 feet, 1979). The 0.2-percent annual chance flood boundaries for the Kern River were added from the Flood Plain Information report for the Kern River (U.S. Department of the Army, Corps of Engineers, October 1969).

In the Hawthorne Ravine-Wilshire Heights area, 1-percent annual chance flood boundaries were delineated using topographic maps at a scale of 1:4,800 with a contour interval of 2 feet (Mason, Vancuren & Wachob, Northeast Bakersfield Drain Study Map, Scale 1:4,800, Contour Interval 2 feet, 1973).

Approximate 1-percent annual chance flood plain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Maps for the City of Bakersfield (U.S. Department of Housing and Urban Development, Federal Insurance Administration, August 1974, revised August 1976 and U.S. Department of Housing and Urban Development, Federal Insurance Administration, June 1978).

On the Kern River downstream of Stockdale Highway, the Shaded Zone X levee-protected area flooding was delineated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (U.S. Department of the Interior, Geological Survey, (1954), Photorevised (1968 and 1973); Rio Bravo Ranch and Oildale, California photorevise (1968)).

City of California City

Between cross sections for the City of California City, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (Cooper Aerial Survey Company, September 1979, unpublished), For a new reach on Tierra del Sol Creek, the boundaries were interpolated using a topographic map at a scale of 1:2,400, with a contour interval of 2 feet (Aerial Photometrics, September 1977),.

For stream channels designated as “1- percent annual chance flood Contained in Channel,” the 1-percent annual chance flood plain boundaries are based on the existing channel alignment and right-of-way.

Boundaries for the shallow flooding areas were delineated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (Cooper Aerial Survey Company, September 1979, unpublished), in conjunction with the previously determined depths.

City of McFarland

For each flooding source studied in detail in the City of McFarland, the 1-and 0.2-percent annual chance flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (Cooper Aerial Survey Company, November 1981).

City of Ridgecrest

For each stream studied in detail for the City of Ridgecrest, the boundaries of the 1-and 0.2-percent annual chance floods have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4800, with a contour interval of 4 feet (Cooper Aerial Survey Company, November 1979).

For some portions of the streams studied, 1-percent annual chance flood boundaries were obtained from the USACE Flood Plain Information report (U.S. Department of the Army, Corps of Engineers, June 1976), and verified by normal-depth calculations. The 0.2-percent annual chance floodplain boundaries for the City of Ridgecrest were delineated from USACE Flood Plain Information Maps (U.S. Department of the Army, Corps of Engineers, June 1976).

In accordance with Federal Insurance Administration guidelines, approximate 1-percent annual chance flood plain boundaries less than 200 feet wide have been deleted.

City of Shafter

For the areas studied by detailed methods in the City of Shafter, the 1-percent annual chance floodplain boundaries have been delineated using hydrologic analyses. The boundaries were interpolated using street survey information (Surveys by Gill and Pulver Engineers, February 1988) and topographic maps at a scale of 1:24,000, with a contour interval of 5 feet (U.S. Department of the Interior, 1953, Photo Revised 1968, Photo Inspected 1973, and Rio Bravo, California 1954, Photo Revised 1968, Photo Inspected).

Approximate 1-percent annual chance floodplain boundaries were delineated using data from the “Contract Documents for Constructing the Shafter Drain and Terminal Sump” (Ricks, Taylor & Meyer, Inc., June 1987) for the City of Shafter.

City of Taft

For each stream studied by detailed methods in the City of Taft, the 1- and 0.2-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 a scale of 1:9,600, with a contour interval of 4 feet (Cooper Aerial Survey, Topographic Maps, June 2, 1979).

City of Tehachapi

For each stream studied in detail in the City of Tehachapi, the boundaries of the 1- and 0.2-percent annual chance floods have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:6000, with a contour interval of 5 feet (Mason, Vancuren and Wacob Civil Engineering, Compiled 1977, unpublished). The boundaries of the approximate and shallow flooding areas were delineated on the same maps.

City of Wasco

For the area studied by detailed methods in the City of Wasco, the 1-percent annual chance floodplain boundary has been delineated using the flood elevations determined from the hydrologic analyses. The boundary limits were interpolated using the city's base map at a scale of 1:4,800, with a contour interval of 1 foot, as determined from the surveyed cross sections (Quad Engineering, Inc., Cross Section Survey, Field Notes, October 1987).

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 floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance 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 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 (see Table 9 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.

Encroachment into areas subject to inundation by floodwater having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 9, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside floodway

The area between the 1-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 of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1, "Floodway Schematic."

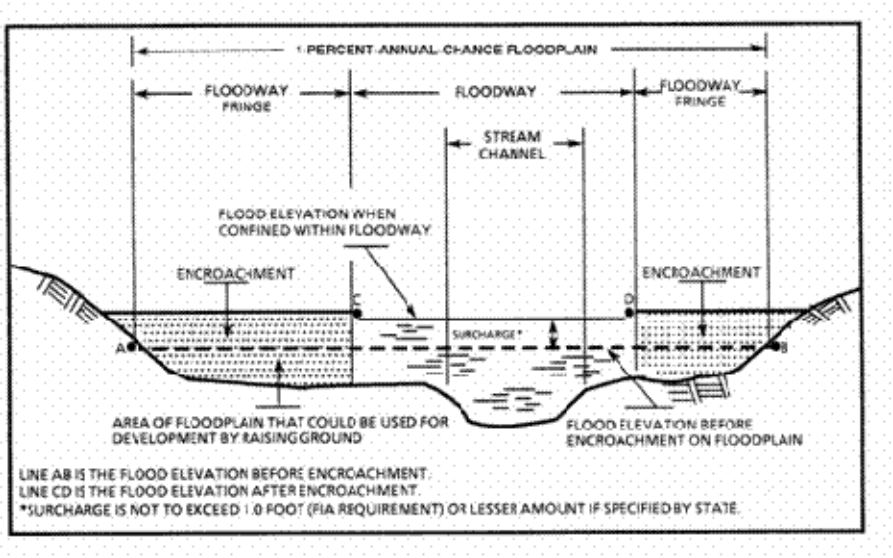


Figure 1 - FLOODWAY SCHEMATIC

Kern County

The revision within the unincorporated areas of Kern County includes the study of Bodfish Creek and East Nicolls Peak alluvial fan. It was incorporated in this Section in 1989 to update the September 26, 1986, Kern County FIS.

In Bodfish Creek the overbank velocities exceeded 7 feet per second at most sections. At these sections the floodway boundaries were made coincident with the 1-percent annual chance floodplain boundaries. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 9). In the alluvial fan area east of Nicolls Peak, the unpredictable flow paths make delineation of a floodway that would meet FEMA criteria impossible. However, the community should regulate development in swales, identifiable stream channels, and areas within fan boundaries based on historical evidence of flow in such areas.

Another revision of this study was on March 2, 1994, to provide flood hazard information based on new analyses of flooding on Sand Canyon, Grapevine Canyon, Short Canyon, Indian Wells Canyon, Freeman Gulch and Short Canyon at Kelso Creek. In areas of shallow and alluvial fan flooding, the unpredictable flow paths make delineation of a floodway that would meet FEMA criteria impossible. However, Kern County should regulate development in swales and identifiable stream channels based on historical evidence of flow in such areas.

Because of high velocities on portions of Cuddy Creek, and through extensive coordination with the KCWA and FEMA, the floodway boundary was agreed to be approximately 50 feet back from the bank when flow was supercritical. Data for these areas were not included in Table 9. In other areas, where overbank velocities exceeded 7 feet per second, floodway boundaries were made coincident with the 1-percent annual chance floodplain boundaries.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Antelope Creek								
A	0	76	724	16.6	3,797.7	3,797.7	3,797.7	0.0
B	350	93	786	15.3	3,813.0	3,813.0	3,813.0	0.0
C	1,250	141	941	12.8	3,837.6	3,837.6	3,837.6	0.0
D	1,870	126	812	14.8	3,853.6	3,853.6	3,853.6	0.0
E	2,380	153	910	13.2	3,864.2	3,864.2	3,864.2	0.0
F	2,680	375	1,240	9.7	3,873.8	3,873.8	3,873.8	0.0
G	2,841	376	3,661	3.3	3,888.9	3,888.9	3,888.9	0.0
H	3,116	362	2,632	4.6	3,889.0	3,889.0	3,889.0	0.0
I	3,336	276	1,012	11.9	3,889.3	3,889.3	3,889.3	0.0
J	3,566	388	1,251	9.6	3,896.1	3,896.1	3,896.1	0.0
K	3,774	368	2,343	3.9	3,902.2	3,902.2	3,902.2	0.0
L	4,224	244	857	10.6	3,904.0	3,904.0	3,904.7	0.7
M	4,664	504	2,281	4.0	3,907.8	3,907.8	3,908.7	0.9
N	5,164	583	1,314	6.9	3,910.6	3,910.6	3,911.0	0.4
O	5,564	803	1,731	5.3	3,915.9	3,915.9	3,916.3	0.4
P	6,264	57	153	9.0	3,929.6	3,929.6	3,930.0	0.4
Q	6,534	149	214	6.4	3,936.5	3,936.5	3,936.5	0.0

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

ANTELOPE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Blackburn Creek								
A [2]	440	504	2,281	4.0	3,907.8	3,907.8 [3]	3,908.7 [3]	0.9
B [2]	940	583	1,314	6.9	3,910.6	3,910.6 [3]	3,911 [3]	0.4
C [2]	1,340	803	1,731	5.3	3,915.9	3,915.9 [3]	3,916.3 [3]	0.4
A	1,790	255	1,252	7.3	3,923.0	3,923.0	3,924.0	1.0
B	1,990	205	1,059	8.6	3,924.9	3,924.9	3,925.3	0.4
C	2,510	275	1,380	6.6	3,928.2	3,928.2	3,929.2	1.0
D	2,870	443	1,534	5.9	3,931.4	3,931.4	3,931.4	0.0
E	3,210	139	638	12.3	3,934.0	3,934.0	3,934.0	0.0

[1] Feet Above Confluence With Antelope Creek

[2] Cross Section in Common With Antelope Creek

[3] Elevation Controlled by Antelope Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

BLACKBURN CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Bodfish Creek								
A	1,200	142	709	12.0	2,444.1	2,444.1	2,444.1	0.0
B	2,400	201	894	9.5	2,487.9	2,487.9	2,488.0	0.1
C	3,250	444	950	7.7	2,516.0	2,516.0	2,516.0	0.0
D	4,150	313	989	7.4	2,553.8	2,553.8	2,553.8	0.0
E	5,050	194	751	9.7	2,594.3	2,594.3	2,595.0	0.7
F	6,120	250	936	7.8	2,642.3	2,642.3	2,642.4	0.1
G	7,750	117	672	10.8	2,720.1	2,720.1	2,720.8	0.7
H	8,900	201[2]	730	10.0	2,774.6	2,774.6	2,774.6	0.0
I	9,900	119	591	12.3	2,825.9	2,825.9	2,826.0	0.1
J	11,030	64	357	10.6	2,890.1	2,890.1	2,890.9	0.8
K	12,270	113	419	9.0	2,956.5	2,956.5	2,957.0	0.5
L	13,670	230[2]	554	6.8	3,038.3	3,038.3	3,038.7	0.4
M	14,570	115[2]	310	12.2	3,096.2	3,096.2	3,096.2	0.0
N	16,750	175[2]	436	8.7	3,233.8	3,233.8	3,233.8	0.0

[1] Feet Above Confluence With Kern River

[2] Bank to Bank Widths

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

BODFISH CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Boron Avenue Creek								
A	0	1,365	1,405	2.8	2,445.7	2,445.7	2,445.7	0.0
B	360	1,785	1,877	2.1	2,448.6	2,448.6	2,448.6	0.0
C	2,010	1,020	1,474	2.6	2,450.2	2,450.2	2,450.2	0.0
D	2,100	980	4,823	0.6	2,454.6	2,454.6	2,454.6	0.0
E	2,600	862	1,213	2.5	2,454.7	2,454.7	2,454.7	0.0
F	3,500	1,000	986	3.0	2,460.2	2,460.2	2,460.6	0.4
G	4,645	200	539	5.6	2,468.8	2,468.8	2,469.2	0.4
H	5,475	373	699	4.3	2,471.6	2,471.6	2,472.4	0.8
I	6,125	430	522	5.7	2,476.6	2,476.6	2,477.4	0.8
J	6,625	416	644	4.7	2,483.3	2,483.3	2,483.9	0.6

[1] Feet Above Cross Section A

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

BORON AVENUE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cache Creek								
A	-1,370	506	2,216	3.5	2,306.0	2,306.0	2,307.0	1.0
B	390	383	1,733	4.5	2,310.9	2,310.9	2,311.2	0.3
C	940	350	1,595	4.9	2,313.1	2,313.1	2,313.7	0.6
D	1,620	556	2,621	3.0	2,315.1	2,315.1	2,315.7	0.6
E	3,060	642	1,921	4.1	2,319.6	2,319.6	2,320.2	0.6
F	3,410	650	1,959	4.0	2,321.6	2,321.6	2,322.1	0.5
G	3,480	610	1,721	4.5	2,322.0	2,322.0	2,322.5	0.5
H	3,740	550	1,942	4.0	2,324.3	2,324.3	2,324.3	0.0
I	5,200	310	1,669	4.7	2,330.2	2,330.2	2,330.9	0.7
J	7,000	526	2,680	2.9	2,334.2	2,334.2	2,335.0	0.8
K	7,570	598	1,051	7.4	2,340.5	2,340.5	2,340.6	0.1
L	7,650	690	8,691	0.9	2,344.7	2,344.7	2,345.3	0.6
M	7,860	770	9,175	0.9	2,344.7	2,344.7	2,345.3	0.6
N	9,710	748	4,455	1.8	2,344.8	2,344.8	2,345.5	0.7
O	11,710	294	957	8.1	2,349.9	2,349.9	2,350.1	0.2
P	12,260	830	2,380	3.3	2,353.3	2,353.3	2,353.8	0.5
Q	12,390	900	3,511	2.2	2,355.3	2,355.3	2,356.1	0.8
R	12,580	790	3,564	2.2	2,355.4	2,355.4	2,356.2	0.8
S	15,050	452	1,615	4.8	2,359.5	2,359.5	2,359.9	0.4
T	17,730	941	2,865	2.7	2,369.0	2,369.0	2,369.1	0.1
U	18,410	717	1,985	3.9	2,370.9	2,370.9	2,371.0	0.1
V	18,537	1,050	5,193	1.5	2,374.4	2,374.4	2,374.8	0.4
W	19,087	1,100	3,412	2.3	2,374.7	2,374.7	2,375.1	0.4
X	20,737	1,050	2,769	2.8	2,377.5	2,377.5	2,377.6	0.1
Y	21,837	1,029	3,129	2.5	2,378.9	2,378.9	2,379.5	0.6
Z	21,912	1,130	3,590	2.2	2,380.9	2,380.9	2,381.4	0.5

[1] Feet Above Confluence With Tierra del Sol Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CACHE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cache Creek (Cont'd)								
AA	23,272	602	1,672	4.7	2,383.4	2,383.4	2,384.0	0.6
AB	25,222	566	2,258	3.5	2,391.7	2,391.7	2,392.6	0.9
AC	27,022	409	1,649	4.7	2,397.7	2,397.7	2,397.7	0.0
AD	28,952	514	1,989	3.9	2,405.2	2,405.2	2,406.2	1.0
AE	30,882	541	1,712	4.6	2,413.7	2,413.7	2,414.4	0.7
AF	32,252	474	1,756	4.4	2,420.3	2,420.3	2,421.2	0.9
AG	33,602	537	1,910	4.1	2,426.9	2,426.9	2,427.6	0.7
AH	34,922	542	1,544	5.1	2,434.5	2,434.5	2,435.4	0.9

[1] Feet Above Confluence With Tierra del Sol Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Caliente Creek								
A	0	282	6,477	5.1	1,233.1	1,233.1	1,234.1	1.0
B	630	244	4,274	7.7	1,233.3	1,233.3	1,234.3	1.0
C	1,240	242	2,257	14.5	1,233.6	1,233.6	1,234.4	0.8
D	1,980	249	2,115	15.5	1,244.9	1,244.9	1,245.0	0.1
E	2,390	238	2,348	14.0	1,250.6	1,250.6	1,251.4	0.8
F	2,940	297	2,519	13.0	1,257.3	1,257.3	1,258.0	0.7
G	3,660	340	2,366	13.8	1,265.4	1,265.4	1,266.2	0.8
H	4,600	715	3,631	9.0	1,276.4	1,276.4	1,277.4	1.0
I	5,760	620	2,775	11.8	1,290.0	1,290.0	1,290.0	0.0
J	6,810	433	3,030	10.8	1,300.7	1,300.7	1,300.8	0.1
K	7,070	633	9,687	3.4	1,307.4	1,307.4	1,308.4	1.0
L	7,610	400	1,731	11.4	1,307.4	1,307.4	1,308.4	1.0
M	8,460	788	2,647	7.5	1,316.4	1,316.4	1,317.2	0.8
N	8,560	781	2,079	9.5	1,318.4	1,318.4	1,318.5	0.1
O	8,945	450	2,359	8.4	1,324.4	1,324.4	1,325.3	0.9
P	9,775	500	1,801	11.0	1,330.8	1,330.8	1,331.5	0.7
Q	10,755	385	1,764	11.2	1,344.3	1,344.3	1,345.2	0.9
R	11,775	253	1,493	13.3	1,356.1	1,356.1	1,356.4	0.3
S	12,785	300	1,623	12.2	1,368.7	1,368.7	1,369.6	0.9
T	13,585	205	1,348	14.7	1,379.5	1,379.5	1,380.2	0.7
U	14,185	211	1,400	14.1	1,389.7	1,389.7	1,390.6	0.9
V	14,925	211	1399	14.2	1,399.8	1,399.8	1,400.5	0.7

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CALIENTE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Caliente Creek Near Loraine								
A	0	257	1,382	12.2	2,654.4	2,654.4	2,654.4	0.0
B	834	420	963	17.5	2,666.9	2,666.9	2,666.9	0.0
C	1,296	258	1,432	11.8	2,678.2	2,678.2	2,678.2	0.0
D	1,925	441	1,381	12.2	2,684.2	2,684.2	2,684.2	0.0
E	2,422	366	1,452	11.6	2,690.2	2,690.2	2,690.2	0.0
F	3,117	404	1,151	14.7	2,700.7	2,700.7	2,700.7	0.0
G	3,674	337	1,552	10.9	2,710.9	2,710.9	2,710.9	0.0
H	4,058	335	1,441	11.7	2,714.2	2,714.2	2,714.2	0.0
I	4,531	348	1,312	12.9	2,720.4	2,720.4	2,720.4	0.0
J	4,897	486	1,778	9.5	2,726.7	2,726.7	2,726.7	0.0
K	5,354	383	1,235	13.7	2,732.4	2,732.4	2,732.4	0.0
L	5,940	455	1,512	11.2	2,739.9	2,739.9	2,739.9	0.0
M	6,582	470	1,748	9.7	2,746.6	2,746.6	2,746.6	0.0
N	7,273	378	1,314	12.9	2,753.9	2,753.9	2,753.9	0.0
O	7,950	330	1,597	10.6	2,764.0	2,764.0	2,764.0	0.0
P	8,509	445	1,762	9.6	2,769.5	2,769.5	2,769.5	0.0
Q	8,834	286	703	10.9	2,772.2	2,772.2	2,772.2	0.0
R	9,216	327	814	9.4	2,777.0	2,777.0	2,777.0	0.0
S	9,659	468	890	8.6	2,781.7	2,781.7	2,781.7	0.0
T	10,249	625	1,013	7.5	2,787.3	2,787.3	2,787.3	0.0
U	10,775	503	608	12.6	2,793.5	2,793.5	2,793.5	0.0
V	11,470	412	893	8.6	2,802.5	2,802.5	2,802.5	0.0
W	12,017	360	784	9.8	2,806.3	2,806.3	2,806.3	0.0
X	12,739	325	977	7.8	2,814.6	2,814.6	2,814.6	0.0
Y	13,364	683	1,016	7.5	2,820.7	2,820.7	2,820.7	0.0
Z	13,940	378	896	8.5	2,828.2	2,828.2	2,828.2	0.0

[1] Feet Above Confluence With Indian Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CALIENTE CREEK NEAR LORAINE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Caliente Creek Near Loraine (Cont'd)								
AA	14,641	395	659	11.6	2,836.7	2,836.7	2,836.7	0.0
AB	15,106	219	710	10.0	2,843.4	2,843.4	2,843.4	0.0
AC	15,546	313	705	10.1	2,846.6	2,846.6	2,846.6	0.0
AD	16,010	264	679	10.5	2,852.5	2,852.5	2,852.5	0.0
AE	16,458	187	604	11.8	2,857.6	2,857.6	2,857.6	0.0
AF	16,849	208	708	10.0	2,862.2	2,862.2	2,862.2	0.0
AG	17,442	139	300	11.2	2,868.0	2,868.0	2,868.0	0.0
AH	18,081	153	406	8.2	2,877.8	2,877.8	2,877.8	0.0
AI	18,648	148	303	11.1	2,885.3	2,885.3	2,885.3	0.0
AJ	19,143	210	403	8.3	2,894.1	2,894.1	2,894.1	0.0
AK	19,805	359	395	8.5	2,903.8	2,903.8	2,903.8	0.0
AL	20,537	405	379	8.8	2,914.8	2,914.8	2,914.8	0.0
AM	21,270	335	464	7.2	2,927.0	2,927.0	2,927.0	0.0
AN	22,073	561	619	5.4	2,938.9	2,938.9	2,938.9	0.0
AO	22,723	516	474	7.1	2,947.3	2,947.3	2,947.3	0.0
AP	23,373	309	401	8.4	2,960.1	2,960.1	2,960.1	0.0
AQ	24,169	286	490	6.8	2,975.9	2,975.9	2,975.9	0.0
AR	24,930	340	255	13.1	2,989.4	2,989.4	2,989.4	0.0
AS	25,358	158	250	13.4	3,000.1	3,000.1	3,000.1	0.0
AT	25,714	199	304	11.0	3,009.6	3,009.6	3,009.6	0.0
AU	26,364	413	408	8.2	3,025.6	3,025.6	3,025.6	0.0
AV	26,784	93	215	15.6	3,036.7	3,036.7	3,036.7	0.0
AW	26,964	67	265	12.6	3,043.9	3,043.9	3,043.9	0.0
AX	27,201	107	272	12.3	3,049.5	3,049.5	3,049.5	0.0
AY	27,898	208	373	9.0	3,066.4	3,066.4	3,066.4	0.0
AZ	28,568	266	274	12.2	3,081.1	3,081.1	3,081.1	0.0

[1] Feet Above Confluence With Indian Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CALIENTE CREEK NEAR LORAINE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Caliente Creek Near Loraine (Cont'd)								
BA	29,148	134	331	10.1	3,094.9	3,094.9	3,094.9	0.0
BB	29,873	204	238	14.1	3,108.8	3,108.8	3,108.8	0.0
BC	30,490	104	290	11.5	3,126.6	3,126.6	3,126.6	0.0
BD	31,130	136	245	13.7	3,144.5	3,144.5	3,144.5	0.0
BE	31,872	169	263	12.8	3,165.5	3,165.5	3,165.5	0.0
BF	32,321	101	228	14.7	3,174.7	3,174.7	3,174.7	0.0
BG	32,774	69	234	14.3	3,184.9	3,184.9	3,184.9	0.0
BH	33,281	232	296	11.3	3,199.3	3,199.3	3,199.3	0.0

[1] Feet Above Confluence With Indian Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CALIENTE CREEK NEAR LORAINE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Caliente Creek Tributary								
A	500	110	100	6.0	2,838.5	2,838.5	2,838.5	0.0
B	1,027	148	89	6.8	2,854.2	2,854.2	2,854.2	0.0
C	1,650	194	121	4.9	2,869.9	2,869.9	2,869.9	0.0
D	2,192	205	48	12.5	2,881.8	2,881.8	2,881.8	0.0
E	2,667	196	57	10.5	2,892.1	2,892.1	2,892.1	0.0
F	3,142	76	65	9.2	2,902.0	2,902.0	2,902.0	0.0
G	3,567	435	145	4.1	2,915.9	2,915.9	2,915.9	0.0
H	3,938	270	90	6.7	2,923.6	2,923.6	2,923.6	0.0
I	4,367	212	106	5.7	2,937.5	2,937.5	2,937.5	0.0
J	4,737	249	92	6.5	2,948.1	2,948.1	2,948.1	0.0
K	5,139	245	87	6.9	2,963.0	2,963.0	2,963.0	0.0

[1] Feet Above Confluence With Caliente Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CALIENTE CREEK TRIBUTARY 1

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cottonwood Creek								
A	50	82	547	14.3	560.2	560.2	560.2	0.0
B	620	206	895	8.7	583.2	583.2	583.2	0.0
C	1,170	203	732	10.7	600.3	600.3	600.3	0.0
D	1,270	158	641	12.2	604.1	604.1	604.1	0.0
E	1,970	118	638	12.2	619.7	619.7	619.7	0.0
F	2,920	171	761	10.2	634.0	634.0	634.0	0.0
G	4,170	350	921	8.5	662.3	662.3	662.3	0.0
H	5,220	324	965	8.1	674.7	674.7	674.7	0.0
I	6,320	366	1,059	7.4	688.9	688.9	688.9	0.0

[1] Feet Above Mouth

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

COTTONWOOD CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cuddy Creek								
A	2,620	2750	--[2]	--[2]	3,554.4	--[2]	--[2]	--[2]
B	3,650	160	--[2]	--[2]	3,577.9	--[2]	--[2]	--[2]
C	4,470	130	--[2]	--[2]	3,596.4	--[2]	--[2]	--[2]
D	4,880	190	--[2]	--[2]	3,608.2	--[2]	--[2]	--[2]
E	5,730	160	--[2]	--[2]	3,628.8	--[2]	--[2]	--[2]
F	6,470	160	--[2]	--[2]	3,646.3	--[2]	--[2]	--[2]
G	6,820	180	--[2]	--[2]	3,656.3	--[2]	--[2]	--[2]
H	7,420	180	--[2]	--[2]	3,672.7	--[2]	--[2]	--[2]
I	7,890	170	--[2]	--[2]	3,688.3	--[2]	--[2]	--[2]
J	8,280	190	--[2]	--[2]	3,700.5	--[2]	--[2]	--[2]
K	8,680	140	--[2]	--[2]	3,711.0	--[2]	--[2]	--[2]
L	8,910	180	--[2]	--[2]	3,716.5	--[2]	--[2]	--[2]
M	9,240	170	--[2]	--[2]	3,724.4	--[2]	--[2]	--[2]
N	9,730	210	--[2]	--[2]	3,742.1	--[2]	--[2]	--[2]
O	10,270	200	--[2]	--[2]	3,757.8	--[2]	--[2]	--[2]
P	10,780	180	--[2]	--[2]	3,768.0	--[2]	--[2]	--[2]
Q	11,360	170	--[2]	--[2]	3,787.4	--[2]	--[2]	--[2]
R	11,930	170	--[2]	--[2]	3,808.2	--[2]	--[2]	--[2]
S	11,950	170	--[2]	--[2]	3,808.5	--[2]	--[2]	--[2]
T	12,943	150	--[2]	--[2]	3,839.6	--[2]	--[2]	--[2]
U	13,943	120	--[2]	--[2]	3,868.4	--[2]	--[2]	--[2]
V	14,593	135	614	12.6	3,887.2	3,887.2	3,887.2	0.0
W	15,413	108	586	13.2	3,915.3	3,915.3	3,915.3	0.0
X	16,013	554	999	7.8	3,934.0	3,934.0	3,934.0	0.0
Y	16,553	320	946	8.2	3,953.7	3,953.7	3,953.7	0.0
Z	17,333	258	627	12.4	3,986.9	3,986.9	3,986.9	0.0

[1] Feet Above Limit of Detailed Study

[2] Data Not Available

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CUDDY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cuddy Creek (Cont'd)								
AA	17,773	96	561	13.8	4,003.8	4,003.8	4,003.8	0.0
AB	18,423	190	708	11.0	4,023.2	4,023.2	4,023.2	0.0
AC	19,113	338	980	7.4	4,046.2	4,046.2	4,046.2	0.0
AD	19,813	151	625	11.6	4,049.9	4,049.9	4,049.9	0.0
AE	20,853	144	615	11.8	4,116.8	4,116.8	4,116.8	0.0
AF	21,583	189	675	10.7	4,158.9	4,158.9	4,159.9	1.0
AG	22,213	322	767	9.4	4,186.7	4,186.7	4,186.7	0.0
AH	22,983	165	643	11.3	4,226.2	4,226.2	4,226.2	0.0
AI	23,673	305	789	9.2	4,257.4	4,257.4	4,257.5	0.1
AJ	24,529	395	797	9.1	4,297.0	4,297.0	4,297.0	0.0
AK	25,069	504	960	7.6	4,320.0	4,320.0	4,320.0	0.0
AL	25,619	155	629	11.5	4,346.8	4,346.8	4,347.6	0.8
AM	26,569	200	703	10.3	4,393.6	4,393.6	4,393.9	0.3
AN	27,219	127	654	11.1	4,425.9	4,425.9	4,426.7	0.8
AO	28,049	80	503	14.4	4,468.3	4,468.3	4,469.0	0.7
AP	28,629	94	507	13.3	4,500.4	4,500.4	4,500.4	0.0
AQ	29,669	132	569	11.9	4,546.5	4,546.5	4,546.5	0.0
AR	30,379	144	304	22.2	4,574.4	4,574.4	4,574.4	0.0
AS	30,979	100	326	20.7	4,602.4	4,602.4	4,602.4	0.0
AT	31,579	108	569	11.9	4,632.2	4,632.2	4,633.1	0.9
AU	32,407	153	351	19.2	4,655.7	4,655.7	4,655.7	0.0
AV	33,157	110	315	21.4	4,686.9	4,686.9	4,686.9	0.0
AW	33,737	127	278	24.3	4,713.5	4,713.5	4,713.5	0.0
AX	34,287	78	287	23.5	4,738.5	4,738.5	4,738.5	0.0
AY	34,952	113	294	22.9	4,766.2	4,766.2	4,766.2	0.0
AZ	35,122	131	505	13.4	4,779.4	4,779.4	4,779.4	0.0

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CUDDY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cuddy Creek (Cont'd)								
BA	35,832	95	272	24.8	4,797.6	4,797.6	4,797.6	0.0
BB	36,412	160	621	9.7	4,822.6	4,822.6	4,822.6	0.0
BC	37,022	117	527	11.4	4,845.7	4,845.7	4,845.7	0.0
BD	37,852	127	589	10.2	4,879.0	4,879.0	4,879.0	0.0
BE	38,392	116	522	11.5	4,901.5	4,901.5	4,901.5	0.0
BF	39,022	238	733	8.2	4,922.4	4,922.4	4,922.4	0.0
BG	39,712	152	567	10.6	4,942.4	4,942.4	4,942.4	0.0
BH	40,442	62	426	14.1	4,966.0	4,966.0	4,966.0	0.0
BI	40,977	103	499	12.0	4,982.6	4,982.6	4,982.6	0.0
BJ	41,992	209	677	8.9	5,006.8	5,006.8	5,006.8	0.0
BK	42,792	185	641	9.4	5,028.7	5,028.7	5,028.7	0.0
BL	43,427	107	525	11.4	5,045.3	5,045.3	5,045.3	0.0
BM	43,987	141	537	11.7	5,057.6	5,057.6	5,057.6	0.0
BN	44,617	191	616	9.7	5,068.9	5,068.9	5,068.9	0.0
BO	45,207	135	589	10.2	5,081.9	5,081.9	5,081.9	0.0
BP	45,652	123	509	11.8	5,093.5	5,093.5	5,093.5	0.0
BQ	46,077	142	576	10.4	5,100.5	5,100.5	5,100.5	0.0
BR	46,477	222	664	7.9	5,104.4	5,104.4	5,104.4	0.0
BS	46,837	56	363	14.5	5,105.3	5,105.3	5,105.5	0.2
BT	47,267	263	743	7.1	5,114.4	5,114.4	5,114.6	0.2
BU	47,627	209	699	7.5	5,119.9	5,119.9	5,120.8	0.9
BV	48,092	47	420	12.5	5,127.0	5,127.0	5,127.0	0.0
BW	48,482	110	512	10.3	5,134.4	5,134.4	5,134.9	0.5
BX	48,962	279	783	6.7	5,142.7	5,142.7	5,143.0	0.3
BY	49,412	411	1,085	4.8	5,144.5	5,144.5	5,145.1	0.6
BZ	50,272	97	260	7.7	5,157.7	5,157.7	5,158.7	1.0

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CUDDY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cuddy Creek (Cont'd)								
CA	51,007	67	202	9.9	5,177.7	5,177.7	5,178.2	0.5
CB	51,562	57	196	10.2	5,194.7	5,194.7	5,195.5	0.8
CC	51,992	30	154	13.0	5,207.4	5,207.4	5,207.4	0.0
CD	52,442	33	158	12.7	5,219.5	5,219.5	5,219.5	0.0
CE	52,892	42	178	11.3	5,226.2	5,226.2	5,227.2	1.0
CF	53,287	62	192	10.4	5,239.3	5,239.3	5,239.3	0.0

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

CUDDY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Erskine Creek								
A	270	330	1795	4.3	2,433.7	2,433.7	2,433.7	0.0
B	670	427	675	11.4	2,437.2	2,437.2	2,437.2	0.0
C	970	530	1,000	7.7	2,448.9	2,448.9	2,448.9	0.0
D	1,470	600	1,122	6.9	2,457.2	2,457.2	2,457.7	0.5
E	1,890	670	1,073	7.2	2,465.3	2,465.3	2,465.9	0.6
F	2,150	560	1,463	5.3	2,468.1	2,468.1	2,469.0	0.9
G	2,800	531	964	8.0	2,479.2	2,479.2	2,479.2	0.0
H	3,520	505	1,026	7.5	2,496.2	2,496.2	2,496.9	0.7
I	3,970	691	1,230	6.3	2,506.3	2,506.3	2,506.7	0.4
J	4,510	575	928	8.3	2,518.0	2,518.0	2,518.0	0.0
K	5,160	638	4,973	1.5	2,536.3	2,536.3	2,536.3	0.0
L	5,760	450	913	8.4	2,556.2	2,556.2	2,556.2	0.0
M	7,060	340	948	8.1	2,594.7	2,594.7	2,594.8	0.1
N	8,120	198	740	10.4	2,632.1	2,632.1	2,632.1	0.0
O	8,970	189	722	10.7	2,662.5	2,662.5	2,662.5	0.0
P	9,770	165	667	11.5	2,695.5	2,695.5	2,695.5	0.0
Q	10,490	138	670	11.5	2,722.9	2,722.9	2,722.9	0.0
R	11,370	98	560	13.7	2,766.6	2,766.6	2,766.6	0.0
S	12,120	112	646	11.9	2,794.8	2,794.8	2,794.8	0.0
T	12,770	149	682	11.3	2,817.4	2,817.4	2,817.4	0.0

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

ERSKINE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Indian Creek								
A	673	320	532	19.2	2,667.4	2,667.4	2,667.4	0.0
B	703	553	1,320	7.7	2,669.6	2,669.6	2,669.6	0.0
C	1,041	242	843	12.1	2,672.2	2,672.2	2,672.2	0.0
D	1,342	244	769	13.3	2,675.9	2,675.9	2,675.9	0.0
E	1,917	334	788	12.9	2,686.1	2,686.1	2,686.1	0.0
F	2,473	291	853	12.0	2,695.7	2,695.7	2,695.7	0.0
G	3,034	255	893	11.4	2,703.8	2,703.8	2,703.8	0.0
H	3,564	391	876	11.6	2,711.3	2,711.3	2,711.3	0.0
I	4,314	555	877	11.6	2,724.4	2,724.4	2,724.4	0.0
J	5,105	396	1,067	9.6	2,737.6	2,737.6	2,737.6	0.0
K	5,650	415	971	10.5	2,744.8	2,744.8	2,744.8	0.0
L	6,324	509	825	12.4	2,755.7	2,755.7	2,755.7	0.0
M	6,617	616	951	10.7	2,761.6	2,761.6	2,761.6	0.0
N	6,850	557	866	11.8	2,765.0	2,765.0	2,765.0	0.0
O	7,354	257	494	20.6	2,773.3	2,773.3	2,773.3	0.0

[1] Feet Above Confluence With Caliente Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

INDIAN CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Jawbone Canyon Wash								
A	3,290	1,323	5,163	7.0	1,996.0	1,996.0	1,996.0	0.0
B	3,560	1,361	6,526	5.5	1,997.3	1,997.3	1,997.7	0.4
C	3,770	1,435	6,757	5.3	1,997.8	1,997.8	1,998.3	0.5
D	5,650	1,846	4,974	7.2	2,006.3	2,006.3	2,007.1	0.8
E	7,050	1,838	8,802	4.1	2,011.3	2,011.3	2,012.0	0.7
F	8,110	1,401	3,883	9.3	2,015.8	2,015.8	2,015.8	0.0
G	8,610	1,241	6,180	5.8	2,019.8	2,019.8	2,020.2	0.4
H	9,020	1,303	7,789	4.6	2,020.8	2,020.8	2,021.4	0.6
I	10,220	926	5,579	6.5	2,023.1	2,023.1	2,023.9	0.8
J	11,480	1,189	6,722	5.4	2,026.9	2,026.9	2,027.7	0.8
K	13,530	1,641	6,578	5.5	2,032.3	2,032.3	2,032.8	0.5

[1] Feet Above Munsey Road

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

JAWBONE CANYON WASH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Kern River at Kernville								
A	0	1,502	8,440	8.2	2,604.9	2,604.9	2,605.9	1.0
B	720	1,728	8,679	8.0	2,608.2	2,608.2	2,608.7	0.5
C	1,990	1,865	7,920	8.7	2,615.1	2,615.1	2,615.1	0.0
D	3,010	2,070	8,301	8.3	2,620.2	2,620.2	2,620.4	0.2
E	4,140	2,597	9,894	7.0	2,625.4	2,625.4	2,625.4	0.0
F	5,330	1,243	6,304	10.9	2,630.0	2,630.0	2,630.0	0.0
G	6,730	562	5,361	12.9	2,637.2	2,637.2	2,637.2	0.0
H	7,770	990	6,501	10.6	2,641.8	2,641.8	2,642.1	0.3
I	8,510	1,175	9,880	7.0	2,645.1	2,645.1	2,645.2	0.1
J	8,835	900	7,170	9.6	2,645.2	2,645.2	2,645.3	0.1
K	9,391	368	5,071	13.6	2,647.4	2,647.4	2,647.5	0.1
L	10,901	815	5,051	13.7	2,656.0	2,656.0	2,656.0	0.0
M	12,151	843	7,119	9.7	2,663.8	2,663.8	2,663.9	0.1
N	12,431	572	5,390	12.8	2,664.8	2,664.8	2,664.8	0.0
O	13,091	840	7,929	8.7	2,667.9	2,667.9	2,668.8	0.9
P	14,021	1,390[2]	5,520	12.5	2,674.4	2,674.4	2,674.4	0.0
Q	15,261	922	6,403	10.8	2,684.2	2,684.2	2,684.2	0.0
R	16,461	920	6,061	11.4	2,690.4	2,690.4	2,690.4	0.0
S	17,421	1,280	6,797	10.2	2,696.1	2,696.1	2,696.1	0.0
T	18,431	1,760	6,938	9.9	2,703.2	2,703.2	2,703.3	0.1
U	19,351	1,040	5,088	13.6	2,707.9	2,707.9	2,707.9	0.0
V	20,451	953[2]	4,778	14.4	2,716.1	2,716.1	2,716.1	0.0
W	20,981	1,101[2]	5,025	13.7	2,721.4	2,721.4	2,721.4	0.0
X	21,501	1,045[2]	4,456	15.5	2,727.1	2,727.1	2,727.1	0.0
Y	22,441	927	7,354	9.4	2,734.1	2,734.1	2,734.3	0.2
Z	23,011	600	4,874	14.2	2,738.2	2,738.2	2,738.5	0.3

[1] Feet Above Limit of Detailed Study

[2] Width Includes High Ground

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

KERN RIVER AT KERNVILLE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Kern River at Kernville (Cont'd)								
AA	23,521	295	3,687	18.7	2,743.7	2,743.7	2,743.7	0.0
AB	24,291	470	5,543	12.4	2,751.8	2,751.8	2,752.2	0.4
AC	24,771	495	5,560	12.4	2,754.9	2,754.9	2,754.9	0.0
AD	25,771	581	4,804	14.4	2,760.1	2,760.1	2,760.1	0.0
AE	26,521	874	5,612	12.3	2,773.2	2,772.3	2,772.3	0.0

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

KERN RIVER AT KERNVILLE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little Dixie Wash								
A	0	379	2,151	2.1	2,414.0	2,414.0	2,414.9	0.9
B	170	439	1,639	2.8	2,414.3	2,414.3	2,415.0	0.7
C	1,550	115	432	10.7	2,421.7	2,421.7	2,421.8	0.1
D	2,925	200	852	5.4	2,430.1	2,430.1	2,430.9	0.8
E	4,655	90	396	11.6	2,440.9	2,440.9	2,441.9	1.0
F	5,735	150	773	5.9	2,449.3	2,449.3	2,449.8	0.5
G	7,135	325	709	6.5	2,455.8	2,455.8	2,456.6	0.8

[1] Feet Above Inyokern Road

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

LITTLE DIXIE WASH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Poso Creek								
A	0	156	507	9.9	417.7	417.7	417.7	0.0
B	3,470	1,150	1,653	8.4	426.4	426.4	426.6	0.2
C	4,870	490	1,366	7.9	429.3	429.3	430.1	0.8
D	6,870	396	1,019	9.5	434.0	434.0	434.6	0.6
E	7,470	425	1,345	8.1	435.6	435.6	436.6	1.0
F	8,570	619	1,803	5.5	437.6	437.6	438.6	1.0
G	10,920	1,066	1,733	7.0	443.9	443.9	444.0	0.1
H	12,580	1,280	2,235	5.2	447.6	447.6	448.0	0.4
I	13,680	1265	1,706	7.4	449.5	449.5	450.3	0.8
J	14,830	1,660	2,620	4.0	452.9	452.9	453.5	0.6
K	18,750	1,767	1,555	5.5	461.4	461.4	461.4	0.0
L	26,860	1,860	3,172	6.0	483.1	483.1	483.2	0.1
M	29,160	1,646	4,016	4.7	488.6	488.6	488.9	0.3
N	30,510	1,715	3,199	5.9	491.6	491.6	492.0	0.4
O	31,610	1,627	3,450	5.5	495.6	495.6	495.6	0.0
P	34,060	1,750	4,761	4.0	499.8	499.8	500.7	0.9
Q	35,410	948	2,866	6.6	502.9	502.9	502.9	0.0
R	36,660	1,189	6,700	2.8	504.2	504.2	504.5	0.3
S	38,000	324	1526	12.4	504.9	504.9	504.9	0.0
T	39,450	519	2126	8.9	512.4	512.4	512.5	0.1
U	40,900	473	2319	8.2	516.8	516.8	516.9	0.1
V	41,980	573	3944	4.8	518.2	518.2	518.7	0.5
W	43,360	241	1383	13.7	519.2	519.2	519.4	0.2
X	44,810	236	1587	12.0	525.3	525.3	526.2	0.9
Y	45,380	213	1423	13.3	528.7	528.7	528.8	0.1

[1] Feet Above State Highway 99

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

POSO CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ranger Station Creek								
A	810	217	519	6.5	5,155.9	5,155.9	5,156.1	0.2
B	1,140	73	296	11.5	5,161.1	5,161.1	5,161.2	0.1
C	1,965	103	351	9.7	5,176.6	5,176.6	5,176.8	0.2
D	2,600	73	306	11.1	5,186.0	5,186.0	5,186.1	0.1
E	3,050	115	453	7.5	5,189.6	5,189.6	5,190.5	0.9
F	3,470	69[2]	299	11.4	5,195.2	5,195.2	5,195.5	0.3

[1] Feet Above Confluence With Cuddy Creek

[2] Floodway Outside Kern County

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

RANGER STATION CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sandy Creek								
A	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
B	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
C	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
D	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
E	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
F	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
G	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
H	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
I	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
J	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
K	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
L	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
M	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
N	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
O	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
P	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
Q	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
R	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
S	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
T	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
U	15,352 [1]	475	—— [2]	—— [2]	1,001.0	—— [2]	—— [2]	—— [2]
V	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
W	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
X	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
Y	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]	—— [2]
Z	17,692 [1]	167	—— [2]	—— [2]	1,059.3	—— [2]	—— [2]	—— [2]

[1] Feet Above Confluence With North Sandy Creek

[2] Data Not Available

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

SANDY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sandy Creek (Cont)								
AA	17,692 [1]	167	__ [2]	__ [2]	1,059.3	__ [2]	__ [2]	__ [2]
AB	19,092 [1]	94	__ [2]	__ [2]	1,095.7	__ [2]	__ [2]	__ [2]
AC	20,752 [1]	98	__ [2]	__ [2]	1,140.2	__ [2]	__ [2]	__ [2]
AD	21,652 [1]	282	__ [2]	__ [2]	1,172.0	__ [2]	__ [2]	__ [2]
AE	21,838 [1]	286	__ [2]	__ [2]	1,173.6	__ [2]	__ [2]	__ [2]
AF	22,768 [1]	119	__ [2]	__ [2]	1,192.0	__ [2]	__ [2]	__ [2]

[1] Feet Above Confluence With North Sandy Creek

[2] Data Not Available

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

SANDY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South Branch Poso Creek								
A	0	4,442	10,811	1.0	445.7	445.7	446.7	1.0
B	1,000	1,720	5,579	1.9	446.2	446.2	446.9	0.7
C	2,650	1,485	3,109	3.4	447.3	447.3	448.0	0.7
D	4,800	1,073	2,146	4.9	453.1	453.1	453.8	0.7
E	7,150	1,713	3,432	3.1	458.2	458.2	458.8	0.6

[1] Feet Above State Highway 99

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

SOUTH BRANCH POSO CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South Fork Kern River								
A	0	2,350	8,284	3.9	2,600.4	2,600.4	2,601.4	1.0
B	2,240	2,970	5,977	5.4	2,608.9	2,608.9	2,608.9	0.0
C	4,470	2,280	9,854	3.2	2,617.5	2,617.5	2,618.1	0.6
D	6,170	2,107	8,820	3.5	2,621.7	2,621.7	2,622.0	0.3
E	6,270	2,000	6,524	4.7	2,621.8	2,621.8	2,622.1	0.3
F	6,303	2,000	13,427	2.3	2,625.7	2,625.7	2,625.7	0.0
G	6,403	2,120	12,591	2.4	2,625.7	2,625.7	2,625.7	0.0
H	9,103	2,110	3,420	8.9	2,628.3	2,628.3	2,628.6	0.3
I	11,953	2,340	9,600	3.0	2,637.4	2,637.4	2,637.8	0.4
J	13,733	1,350	4,226	6.5	2,640.5	2,640.5	2,640.8	0.3
K	15,373	980	5,622	4.9	2,645.6	2,645.6	2,645.9	0.3
L	18,013	2,446	3,447	7.6	2,654.9	2,654.9	2,654.9	0.0
M	18,114	2,450	4,010	6.5	2,658.0	2,658.0	2,658.3	0.3
N	18,155	2,450	6,712	3.9	2,659.0	2,659.0	2,659.5	0.5
O	18,256	2,500	10,747	2.2	2,659.2	2,659.2	2,659.8	0.6
P	19,896	1,600	5,771	3.8	2,660.6	2,660.6	2,660.9	0.3
Q	21,971	1,270	3,712	6.0	2,667.8	2,667.8	2,667.9	0.1
R	24,146	1,470	6,195	3.6	2,674.5	2,674.5	2,675.2	0.7
S	26,146	1,000	3,447	6.4	2,680.6	2,680.6	2,681.0	0.4
T	27,946	1,450	6224	3.6	2,686.6	2,686.6	2,687.2	0.6
U	29,871	2,050	6,144	3.6	2,691.0	2,691.0	2,691.3	0.3
V	31,941	1,250	4446	5.0	2,697.2	2,697.2	2,697.8	0.6
W	33,966	1,190	5170	4.3	2,702.3	2,702.3	2,703.0	0.7
X	35,726	1,240	5485	4.0	2,705.5	2,705.5	2,706.2	0.7
Y	37,386	1,000	5435	4.1	2,707.9	2,707.9	2,708.5	0.6
Z	37,616	1,320	10461	2.1	2,712.8	2,712.8	2,712.9	0.1

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

SOUTH FORK KERN RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South Fork Kern River (Cont'd)								
AA	38,516	580	2,045	10.8	2,712.8	2,712.8	2,713.2	0.4
AB	40,216	450	4,292	5.0	2,721.0	2,721.0	2,721.9	0.9
AC	42,246	380	2,674	8.0	2,725.4	2,725.4	2,726.4	1.0
AD	43,646	310	3,076	7.0	2,732.4	2,732.4	2,733.2	0.8
AE	45,396	480	3,519	6.1	2,738.1	2,738.1	2,738.8	0.7
AF	47,196	420	3,777	5.7	2,743.7	2,743.7	2,744.1	0.4
AG	48,971	236	2,386	9.0	2,749.6	2,749.6	2,749.9	0.3
AH	51,471	950	4,261	5.0	2,761.7	2,761.7	2,762.3	0.6

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

SOUTH FORK KERN RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tierra del Sol Creek								
A	220	200	532	4.3	2,310.0	2,310.0	2,311.0	1.0
B	700	135	367	7.6	2,314.1	2,314.1	2,314.3	0.2
C	1,720	165	646	4.3	2,321.5	2,321.5	2,322.0	0.5
D	2,250	320	485	5.8	2,326.1	2,326.1	2,326.3	0.2
E	2,472	370	685	4.1	2,327.0	2,327.0	2,327.7	0.7
F	2,742	385	1,447	1.9	2,328.4	2,328.4	2,328.7	0.3
G	4,172	265	578	4.8	2,331.3	2,331.3	2,331.8	0.5
H	5,452	221	605	4.6	2,341.5	2,341.5	2,342.2	0.7
I	5,572	352	795	3.5	2,341.7	2,341.7	2,342.7	1.0
J	6,072	108	281	9.8	2,343.8	2,343.8	2,344.1	0.3
K	6,582	605	436	6.0	2,349.2	2,349.2	2,349.7	0.5
L	6,742	750	1,396	1.9	2,350.4	2,350.4	2,351.1	0.7
M	6,877	600	1,407	1.9	2,350.6	2,350.6	2,351.1	0.5
N	7,307	160	552	4.8	2,350.9	2,350.9	2,351.6	0.7
O	7,807	81	338	7.8	2,352.8	2,352.8	2,352.8	0.0
P	8,287	322	547	4.8	2,354.3	2,354.3	2,355.1	0.8
Q	8,627	460	542	4.6	2,355.5	2,355.5	2,356.1	0.6
R	8,747	410	1166	2.1	2,356.1	2,356.1	2,356.8	0.7
S	9,042	80	439	5.7	2,356.2	2,356.2	2,356.8	0.6
T	9,692	80	425	5.9	2,357.4	2,357.4	2,358.1	0.7
U	10,427	95	253	9.3	2,360.8	2,360.8	2,360.8	0.0
V	10,562	103	348	6.8	2,362.6	2,362.6	2,362.9	0.3
W	11,362	165	838	2.8	2,363.8	2,363.8	2,364.6	0.8
X	12,082	139	320	7.0	2,370.1	2,370.1	2,370.5	0.4
Y	12,482	200	558	4.0	2,371.7	2,371.7	2,372.6	0.9

[1] Feet Above Confluence With Cache Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

TIERRA DEL SOL CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Upper Sycamore Creek								
A	0	71	308	9.4	4,030.5	4,030.5	4,030.5	0.0
B	740	83	372	7.8	4,035.3	4,035.3	4,035.3	0.0
C	1,505	69	379	6.1	4,037.8	4,037.8	4,037.8	0.0
D	2,255	319	583	5.0	4,043.0	4,043.0	4,043.0	0.0
E	2,305	299	1,038	2.8	4,043.4	4,043.4	4,043.4	0.0
F	2,665	320	934	3.1	4,043.7	4,043.7	4,043.7	0.0
G	2,706	346	947	3.1	4,043.7	4,043.7	4,043.7	0.0
H	2,966	751	2,614	1.1	4,043.9	4,043.9	4,043.9	0.0
I	3,781	1,023	3,339	0.9	4,044.0	4,044.0	4,044.0	0.0
J	4,381	261	828	3.5	4,044.0	4,044.0	4,044.0	0.0
K	4,601	176	287	7.3	4,046.2	4,046.2	4,047.2	1.0
L	5,651	415	854	2.4	4,049.2	4,049.2	4,050.2	1.0
M	6,751	266	346	6.0	4,052.8	4,052.8	4,053.2	0.4
N	7,491	512	900	2.3	4,055.4	4,055.4	4,055.7	0.3
O	7,566	501	907	2.3	4,062.4	4,062.4	4,063.4	1.0
P	7,766	1,206	5,959	0.3	4,062.8	4,062.8	4,063.4	0.6
Q	8,466	365	814	2.6	4,063.0	4,063.0	4,063.8	0.8
R	9,116	304	437	4.8	4,066.6	4,066.6	4,067.3	0.7
S	9,616	153	290	7.2	4,073.8	4,073.8	4,074.1	0.3
T	9,936	99	232	9.0	4,080.4	4,080.4	4,081.3	0.9
U	10,346	199	350	6.0	4,088.1	4,088.1	4,088.7	0.6
V	10,836	61	200	10.4	4,096.4	4,096.4	4,096.4	0.0
W	11,481	137	317	6.6	4,105.5	4,105.5	4,106.0	0.5
X	12,011	114	286	2.2	4,106.8	4,106.8	4,107.5	0.7
Y	13,251	471	1,613	0.4	4,106.9	4,106.9	4,107.6	0.7
Z	14,191	708	2,182	0.3	4,107.0	4,107.0	4,107.7	0.7

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

UPPER SYCAMORE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Upper Sycamore Creek (Cont'd)								
AA	15,101	985	3,808	0.2	4,107.0	4,107.0	4,107.7	0.7
AB	15,801	838	2,873	0.2	4,107.0	4,107.0	4,107.7	0.7
AC	16,576	428	617	1.0	4,107.3	4,107.3	4,107.8	0.5
AD	17,351	246	279	2.3	4,108.8	4,108.8	4,108.9	0.1
AE	18,791	176	149	3.2	4,116.2	4,116.2	4,116.3	0.1
AF	20,191	98	88	5.5	4,146.6	4,146.6	4,146.6	0.0
AG	21,151	421	322	1.0	4,172.7	4,172.7	4,172.7	0.0

[1] Feet Above Limit of Detailed Study

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

UPPER SYCAMORE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Weaver Creek								
A	1,000	276	476	9.5	2,877.9	2,877.9	2,877.9	0.0
B	1,621	117	317	14.2	2,884.4	2,884.4	2,884.4	0.0
C	2,100	112	397	11.3	2,895.1	2,895.1	2,895.1	0.0
D	2,678	132	301	14.9	2,905.6	2,905.6	2,905.6	0.0
E	3,266	261	495	9.1	2,920.5	2,920.5	2,920.5	0.0
F	3,856	205	246	18.3	2,927.8	2,927.8	2,927.8	0.0
G	4,408	328	461	9.8	2,943.2	2,943.2	2,943.2	0.0
H	4,690	286	343	13.1	2,948.8	2,948.8	2,948.8	0.0
I	5,125	327	332	13.6	2,958.8	2,958.8	2,958.8	0.0
J	5,697	105	254	17.7	2,970.6	2,970.6	2,970.6	0.0
K	6,366	159	380	11.9	2,989.9	2,989.9	2,989.9	0.0
L	6,926	238	389	11.6	3,001.7	3,001.7	3,001.7	0.0
M	7,478	137	308	14.6	3,016.2	3,016.2	3,016.2	0.0

[1] Feet Above Confluence With Caliente Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CALIFORNIA

AND INCORPORATED AREAS

FLOODWAY DATA

WEAVER CREEK

Because the Kelso Creek levee does not meet FEMA standards for freeboard, a floodway was computed for the reach of Kelso Creek along the levee. Below the levee the flow is not channelized, and therefore, a floodway would not be appropriate.

For portions of Erskine Creek, no encroachment was allowed because of hazardous velocities. A floodway was not computed for two sections of the upper reach of Little Dixie Wash upstream of Southern Pacific Railroad and U.S. Highway 395 where split flows occur.

Floodways were not computed for the upper reach of Caliente Creek and its tributaries because of high velocities. However, at the request of Kern County, the floodways were delineated on the Flood Boundary and Floodway Map (FBFM) as equal to the entire floodplain.

The special flood hazard areas at the community of Mojave are areas of shallow flooding, and therefore the concept of a floodway was not applied to this community.

City of Bakersfield

No floodway was computed for the Kern River as a part of this study because the City of Bakersfield currently regulates the flood plain using a floodway that exceeds FEMA requirements. The Designated Floodway for the Kern River as regulated by the City of Bakersfield was developed by the California DWR, Reclamation Board, and based on a peak discharge of 15,000 cfs, which exceeds the 1-percent annual chance flood determined for this FIS.

Cottonwood Creek will be flowing with a high velocity (greater than 7 feet per second) along the overbanks for the 1-percent annual chance flood. It was decided not to allow encroachment due to the high velocities; therefore, the floodway is the same as the 1-percent annual chance flood plain.

A floodway was not determined for the Hawthorne Ravine-Wilshire Heights area due to shallow flooding conditions.

City of McFarland

The special flood hazard areas in McFarland are areas of shallow flooding; therefore, the concept of a floodway is not applicable to this community.

City of Shafter

No floodways were computed for the ponding areas studied by detailed methods in the City of Shafter.

City of Taft

No floodways were computed for flooding sources studied by detailed methods in the City of Taft due to the narrow floodplains.

City of Tehachapi

Flood plain areas within Tehachapi are generally fully developed and subject to shallow flooding. In addition, stream channels are poorly defined. Therefore, floodways are only appropriate in the northwestern region of the city where flows are well defined and the flood plain is undeveloped.

City of Wasco

No floodways were computed for the ponding area studied by detailed methods in the City of Wasco.

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 1-percent annual chance floodplain that is determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or base flood depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplain that is determined in the FIS report by detailed methods. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

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

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, areas of

1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No Base Flood Elevations or base flood depths are shown within this zone.

Zone D

Zone D is the flood insurance risk zone that corresponds to unstudied area where flood hazards are undetermined, but possible.

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 in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot Base Flood Elevations or average depths. Insurance agents use the 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 0.2-percent annual chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of Kern County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the county identified as flood-prone. The countywide FIRM also includes flood hazard information that was presented separately on FBFMs, where applicable. Historical data relating to the maps prepared for each community are presented in Table 10, “Community Map History.”

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Kern County (Unincorporated)	June 20, 1978	None	September 29, 1986	September 29, 1989 September 28, 1990 March 2, 1994 September 6, 1995
Arvin , City of	August 4, 1987	None	August 4, 1987	None
Bakersfield, City of	August 16,1974	August 6, 1976	May 1, 1985	None
California City, City of	April 15,1977	None	January 20, 1982	September 19, 1984
Delano, City of	September 26, 2008	None	None	September 26, 2008
Maricopa, City of	June 14, 1974	November 14, 1975	September 24, 1984	None
McFarland, City of	June, 28 1974	August 15, 1975	September 29, 1986	None
Ridgecrest, City of	September 6, 1974	February 4, 1977	January 6, 1982	None
Shafter, City of	February 6, 1976	None	September 29, 1989	None
Taft, City of	June 28, 1974	March 26, 1976	September 30, 1992	None
Tehachapi, City of	July 30, 1976	July 26, 1977	June 15, 1982	None
Wasco, City of	May 17, 1974	January 5, 1982	July 4, 1989	None

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

KERN COUNTY, CA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Kern County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Kern County.

FISs and/or FIRMs have been prepared for the following communities: City of California City (Federal Emergency Management Agency, 1984); Inyo County (Federal Emergency Management Agency, 1984); Los Angeles County (Federal Emergency Management Agency, 1985); City of Maricopa (Federal Emergency Management Agency, 1984); City of McFarland Federal Emergency Management Agency, 1984); City of Ridgecrest (Federal Emergency Management Agency, 1984); San Bernardino County (Federal Emergency Management Agency, 1985); San Luis Obispo County, Santa Barbara County (Federal Emergency Management Agency, 1985); City of Taft (Federal Emergency Management Agency, 1984); City of Tehachapi (Federal Emergency Management Agency, 1985); and Ventura County (Federal Emergency Management Agency, 1985). The results of those studies agree with the results of this study.

The following Flood Hazard Boundary Maps have been prepared, and are in agreement, with this Kern County study: Kings County (U.S. Department of Housing and Urban Development, 1978); City of Shafter (U.S. Department of Housing and Urban Development, 1976); and City of Wasco (U.S. Department of Housing and Urban Development, 1982).

The floodplain boundaries for this study and the FIS for Tulare County (Federal Emergency Management Agency, 1986) do not agree. The data prepared for Tulare County did not extend into Kern County. Floodplain boundary discrepancies do exist between the City of Bakersfield (Federal Emergency Management Agency, 1985) and Kern County because of discrepancies in the scope of study. The zone designations within the City of Tehachapi do not match this study (Federal Emergency Management Agency, 1985). This disagreement was discussed with and approved by FEMA.

Kern County

A Flood Hazard Boundary Map was previously published for the unincorporated areas of Kern County (U.S. Department of Housing and Urban Development, 1978). The initial FIS published for Kern County in 1986 represented a more detailed analysis, and therefore superseded it. This study supersedes the initial FIS therefore is authoritative for the purposes of the National Flood Insurance Program.

In the 1989 revisions the KCWA developed interim floodplain zones along Bodfish Creek for the same reach as in this study (Kern County Water Agency, 1984). They used a discharge of 13,800 cfs throughout the reach which resulted in significantly wider 1-percent annual chance flood limits than computed in the current study.

The Sacramento District USACE reanalyzed the lower 14,000-foot reach of Bodfish Creek upon request of the KCWA (U.S. Department of the Army, 1985). They utilized the 13,800 cfs discharge provided by the KCWA without reviewing it. The resulting

floodplain limits generally reflected those of the KCWA's interim floodplain. The USACE was unable to conduct standard detailed hydraulic analyses and hence an official map and report were never published. The transmittal letter with the flood boundary maps contained a severe warning of potential flood hazard along Bodfish Creek which could not be reflected using the standard HEC-2 analysis. According to the COE, "These areas could be subject to any of the following: severe erosion; large deposits of sedimentation; extreme velocities; or some combination of these conditions."

The Kern County Public Works Department delineated flood limits (of an unspecified frequency) for the Valley Estates (U.S. Department of the Army, 1985). A discharge of 2,000 cfs was obtained from the County of Kern thunderstorm runoff curves. The flood limits were determined using normal depth calculations. Because of the alluvial nature of the East Nicolls Peak Watershed this revision using the FEMA alluvial fan procedures supersedes the previous work.

The KCWA determined 1-percent annual chance floodplain delineation for Short, Chollo and Cane Canyons which are alluvial fan watersheds just across the valley from the East. Nicolls Peak study area (Kern County Water Agency, 1985).

City of Bakersfield

In the City of Bakersfield the USACE published a 1969 Floodplain Information report for the Kern River (U.S. Department of the Army, Corps of Engineers, October 1969). The 1-percent annual chance flows determined by the USACE were calculated including expected probability and are not acceptable for flood insurance purposes. The USACE revised their hydrologic data in 1979 to eliminate expected probability (U.S. Department of the Army, Corps of Engineers, January 1979). The revised flows were adopted for use in this FIS. The Standard Project Flood was not significantly affected by the USACE revised hydrology. Therefore, the Standard Project Flood was used to delineate the 0.2-percent annual chance flood boundaries for this FIS.

The California DWR developed Designated Floodway maps for the Kern River (California Department of Water Resources, 1976 and 24). The Designated Floodway maps are used by Bakersfield to regulate development in the flood plain.

Mason, Vancuren & Wachob prepared a 1973 engineering study to determine storm drain capacities in the Hawthorne Ravine and Wilshire Heights Drainage Basin (Mason, Vancuren & Wachob, Preliminary Engineering Report, June 1973). The storm drains were determined to contain the 25-year flood.

Flood Hazard Boundary Maps have been prepared for the City of Bakersfield and the unincorporated areas of Kern County (U.S. Department of Housing and Urban Development, Federal Insurance Administration, August 1974, revised August 1976 and 22). Approximate 1-percent annual chance flood boundaries from these maps have been included in the Bakersfield FIS.

City of California City

In the City of California City unpublished studies by the USACE and KCWA (U.S. Department of the Army, Corps of Engineers, unpublished and Kern County Water Agency, Calculations, File 100-6, unpublished) were reviewed during the engineering analyses. These studies are superseded by this FIS.

Unpublished studies by the USACE and KCWA (U.S. Department of the Army, Corps of Engineers, unpublished and Kern County Water Agency, Calculations, File 100-6, unpublished) were reviewed during the engineering analyses. These studies are superseded by this FIS.

For the Kern County FIS, the study contractor is performing approximate studies of Cache Creek upstream from, but not adjacent to, the detailed study areas within California City (Federal Emergency Management Agency, Flood Insurance Study, Kern County, California [Unincorporated Areas], unpublished).

A Flood Hazard Boundary Map was published for the City of California City in 1977 (U.S. Department of Housing and Urban Development, April 1977). This study is a more detailed analysis; therefore, it supersedes the previous map.

City of McFarland

A Flood Hazard Boundary Map has been published for the City of McFarland (U.S. Department of Housing and Urban Development, August 15, 1975; Chow, Ven T., Open - Channel Hydraulics, New York: McGraw-Hill, 1959; King, H.W., Handbook of Hydraulics, 6th Edition, 1963). This study represents a more detailed analysis and, therefore, supersedes the Flood Hazard Boundary Map.

City of Ridgecrest

Two published studies were found which relate to flooding in Ridgecrest: (1) the previously mentioned Flood Plain Information report prepared by the USACE (City of Ridgecrest, Planning Department, General Plan, 1981-1995, Draft Copy, 1980); and (2) a FIS for adjacent San Bernardino County (U.S. Department of Housing and Urban Development, September 1978). Both studies were found to be in agreement with the study within the City of Ridgecrest. Information presented in this study supersedes the existing Flood Hazard Boundary Map for Ridgecrest (U.S. Department of Housing and Urban Development, February 1977; Benjamin, J.R., and C.A. Cornell, Probability, Statistics and Decision for Civil Engineers, New York: McGraw - Hill, 1970, Chow, Ven T., Open-Channel Hydraulics, New York: McGraw-Hill, 1959).

The study within the City of Ridgecrest is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

City of Shafter

This study for the unincorporated areas of Kern County supersedes the City of Shafter Flood Hazard Boundary Map dated February 6, 1976 (Department of Housing and Urban Development, Flood Insurance Administration, Flood Hazard Boundary Map, H - 01, City of Shafter, Community No. 060082, Scale: 1 inch equals 800 feet.).

A study of hydrology and hydraulics of flood flow in the Shafter area, entitled “Shafter Drainage Study, Volume I & II,” was made by Ricks, Taylor & Meyer, Inc., for the City (Ricks, Taylor & Meyer, Inc., no date and Ricks, Taylor & Meyer, Inc., Shafter Drainage Study, Volume II, 25 Year Hydrology, no date). This study for the unincorporated areas of Kern County is in agreement with the Ricks, Taylor & Meyer, Inc. study.

The floodplains presented in this study add to the flood limits delineated in the Kern County unincorporated areas study (Federal Emergency Management Agency, Kern County Unincorporated Areas Flood Insurance Study, January 1988).

City of Taft

A FIS for Kern County was published September 28, 1990 (Federal Emergency Management Agency, Flood Insurance Study, September 28, 1990). Data in this study agrees with the county study. A Flood Hazard Boundary Map for the City of Taft was published June 28, 1974. It was later rescinded on August 23, 1982 (U.S. Dept. of Housing and Urban Development, 1978). This study is authoritative for the purposes of the National Flood Insurance Program.

City of Tehachapi

No published studies were found to exist at the time of the study within the City of Tehachapi other than the NRCS Tehachapi Watershed Study (U.S. Department of Agriculture, Soil Conservation Service, September 1975). That study is in agreement with the results of this FIS. The study within the City of Tehachapi supersedes the Flood Hazard Boundary Map for Tehachapi (U.S. Dept. of Housing and Urban Development, 1977).

City of Wasco

The study within the City of Wasco supersedes the City of Wasco Flood Hazard Boundary Map dated January 5, 1982 (Revised) (U.S. Department of Housing and Urban Development, January 5, 1982). There are no other flood studies of the area.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Region IX, Federal Insurance and Mitigation Administration, 1111 Broadway, Suite 1200, Oakland, California 94607-4052.

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