FLOOD INSURANCE STUDY

STANISLAUS COUNTY, CALIFORNIA,
AND INCORPORATED AREAS

Community Name	Community Number
CERES, CITY OF	060385
HUGHSON, CITY OF	060386
MODESTO, CITY OF	060387
NEWMAN, CITY OF	060388
OAKDALE, CITY OF	060389
PATTERSON, CITY OF	060390
RIVERBANK, CITY OF	060391
STANISLAUS COUNTY (UNINCORPORATED AREAS)	060384
*TURLOCK, CITY OF	060392
WATERFORD, CITY OF	060393

*Non-Floodprone Community

EFFECTIVE DATE:

SEPTEMBER 26, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06099CV000A

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

Old Zone	New Zone
A1 through A30	AE
B	X
C	X

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 STUDY
STANISLAUS COUNTY, CALIFORNIA, AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide 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 Stanislaus County, California, including the Cities of Ceres, Hughson, Modesto, Newman, Oakdale, Patterson, Riverbank, Turlock and Waterford, and the unincorporated areas of Stanislaus County (hereinafter referred to collectively as Stanislaus County). The City of Turlock, does not contain any Special Flood Hazard Areas (SFHAs) and is non-flood prone.

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Stanislaus County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the 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.

This FIS was prepared to include all jurisdictions within Stanislaus County into a countywide format FIS. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

<u>Modesto, City of</u>

The hydrologic and hydraulic analyses for the May 7, 2001 FIS were performed by the U.S. Geological Survey (USGS), for the Federal Insurance Administration (FIA), under Inter-Agency Agreement No. IAA-H-8-76, Project Order No. 7. That study was completed in February 1978.

Newman, City of

The hydrologic and hydraulic analyses for the initial FIS were prepared by the USGS, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-H-8-76, Project No. 14. That study was published in march 1978.

The hydrologic and hydraulic analyses for the January 3, 1990 FIS were prepared by the U.S. Army Corps of Engineers (USACE), Sacramento District, for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 3. This work was completed in November 1987.

Patterson, City of

The hydrologic and hydraulic analyses for the initial study were performed by the USGS for FEMA under Inter-Agency No. IAA-H-8-76, Project Order No. 7. That study was published in February 1979.

The hydrologic and hydraulic analyses for the January 3, 1990 FIS were prepared by the USACE, Sacramento District, for FEMA, under Inter-Agency Agreement EMW-86-E-2226, Project Order No. 3. That work was completed in November 1987.

Riverbank, City of

A Flood Hazard Mitigation Study for the Stanislaus River was incorporated into the September 30, 2004 FIS. That study was prepared by the USACE, Sacramento District for FEMA under authority of Federal Disaster Designation DR-1155. That study was completed in May 2001 (Reference 1).

Stanislaus County (Unincorporated Areas)

The hydrologic and hydraulic analyses for the initial study were performed by the USGS, for FEMA, under Inter-Agency Agreement No. IAA-H-8-76, Project Order No. 2, Amendment No. 2. That work was completed in August 1978.

The hydrologic and hydraulic analyses for the restudy were performed by the USACE, Sacramento District, for FEMA, under Inter-Agency Agreement EMW-86-E-2226, Project Order No. 3. That work was completed in November 1987.

A Flood Hazard Mitigation Study for the Stanislaus River was incorporated into the September 30, 2004 FIS. That study was prepared by the USACE, Sacramento District for FEMA under authority of Federal Disaster Designation DR-1155. That study was completed in May 2001 (Reference 1).

Waterford, City of

The hydrologic and hydraulic analyses for the January 1979 FIS were performed by the USGS, for the FIA, under Inter-Agency Agreement No. IAA-H-17-75, Project Order No. 7. That work was completed in February 1978.

The authority and acknowledgements for the Cities of Ceres, Hughson, Oakdale, and Turlock are not included because there was no previously printed FIS report.

For this countywide FIS, Map IX-Mainland compiled existing data into a digital, countywide format under contract No. EMF-2003-CO-0047. This study was completed in October 2007.

Base map information shown on the FIRM was derived from multiple sources. This information was compiled from the National Geodetic Survey, 2002, FEMA, 2004, and USGS, 1989 and 1993. Additional information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2002.

The coordinate system used for the production of this FIRM was Universal Transverse Mercator (UTM) Zone 10. The horizontal datum was the North American Datum of 1983 (NAD 83), GRS80 spheroid. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

An initial Consultation Coordination Officer's (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 held typically with the same representatives to review the results of the study.

The dates of the initial and final CCO meetings held for the communities within Stanislaus County are shown in Table 1, "Initial and Final CCO Meetings".

TABLE 1 – INITIAL AND FINAL CCO DATES

Community Name	Initial CCO Date	Final CCO Date
City of Modesto	*	April 3, 1979
First Revision	*	*
City of Newman	June, 1975	January 25, 1977
First Revision	April 24, 1985	February 15, 1989
City of Patterson	June, 1975	December 20, 1977
First Revision	April 24, 1985	February 15, 1989
City of Riverbank	September 10/11, 2001	*
Stanislaus County (Unincorporated Areas)	December 18, 1974	April 3, 1979
First Revision	April 24, 1985	*

*Date not available

TABLE 1 – INITIAL AND FINAL CCO DATES - continued

Community Name	Initial CCO Date	Final CCO Date
Second Revision	*	*
Third Revision	September 10/11, 2001	*
Waterford, City of	June 11, 1975	July 11, 1978

*Date not available

For this countywide FIS, an initial CCO meeting was held on May 25, 2005. This meeting was attended by representatives of Stanislaus County, FEMA Region IX, and Map IX Mainland.

A final CCO meeting was held on November 30, 2007. This meeting was attended by representatives of Stanislaus County, FEMA Region IX, and the California Department of Water Resources (DWR).

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Stanislaus County, California.

All or portions of the following streams were studied by detailed methods: Del Puerto Creek, Dry Creek, Orestimba Creek, Salado Creek, Stanislaus River, and Tuolumne River. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

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

Numerous streams were studied by approximate methods. 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 Stanislaus County.

This countywide FIS incorporates two Letters of Map Revision: case number 01-09-1115P, dated August 23, 2002, and case number 93-09-637P, dated August 27, 1993.

This countywide FIS also reflects a vertical datum conversion from the National Geodetic Vertical Datum of 1929 (NGVD 29) to the North American Vertical Datum of 1988 (NAVD 88).

2.2 Community Description

Stanislaus County, situated approximately 80 miles east of San Francisco, is bounded by San Joaquin, Calaveras, Tuolumne, Mariposa, Merced, Santa Clara, and Alameda Counties. The estimated 2006 population was 512,138 (Reference 2). Of these persons, 205,721 live in the City of Modesto, the county seat, and 193,897 live in the incorporated cities of Turlock, Ceres, Riverbank, Oakdale, Patterson, Newman, Waterford, and Hughson (listed largest to smallest) (Reference 2). The total population in the unincorporated areas was 112,520 (Reference 2). The economy of the county is based primarily on agriculture and related industries.

The county straddles the main trough of the San Joaquin Valley and extends from the western foothills of the Sierra Nevada on the east to the crest of the Diablo Range section of the Coast Range Mountains on the west.

Native Americans originally inhabited the western portion of Stanislaus County. Then, in 1806, Gabriel Moraga led a Spanish expiation into the region and discovered and named the Stanislaus River. He later commanded two other expeditions through the area in 1808 and 1810. Spanish settlement started in the region soon after, some beginning as early as 1820. John C. Freemont traveled the region in early 1844 during his explorations in the far west. In 1849, a ferry across the San Joaquin River (called Hill's Ferry) at a site about 5 miles northeast of Newman was begun by a man named Thompson. Greater settlement began in the early 1850's when the Gold Rush era began to decline and more American pioneers started entering the area. Stanislaus County was organized in 1854 after being partitioned off from Tuolumne County. The City of Newman was founded in 1887 and incorporated in June 1908. the City of Patterson was founded and incorporated in December 1919.

Originally, the land in the study areas was used mainly for livestock production and dairying. Pasture, grain, cattle feed, and some row crops predominated. With the advent of an ample water supply, orchards, especially walnut and almond trees, were introduced in the area. Walnut and apricot orchards and, more recently, sod production are now widespread in the area. Sugar beets, peas, broccoli, and spinach are also grown extensively. Stanislaus County, one of the foremost agricultural counties in the state, has a combination of fertile soil, a mild climate, and an abundance of irrigation water, making possible a large variety of agricultural crops. Land in the study area is still devoted almost exclusively to agricultural pursuits, and the present economic base remains predominantly associated with agriculture and related industries. The production of fruit, nuts, vegetables, and field crops are of primary importance, although dairy and poultry farming are also significant. Included in related industrial activities are food processing, food freezing, fruit and vegetable packing, and the production of farm implements. Irrigation is of vital importance to the areas agriculture.

The climate is characterized by hot, dry summers and cool winters. The mean annual precipitation varies from 10 inches on the San Joaquin Valley floor to 18 inches at both the eastern and western county limits (Reference 3). Flood-producing rainstorms occur between November and April.

The topography ranges from 25 feet National Geodetic Vertical Datum of 1929 (NGVD 29) in the San Joaquin River floodplain near the confluence of the Stanislaus River to 3,804 feet NGVD 29 on the top of Mount Stakes in the Diablo Range. There is a distinct transition from the irregular terrain of the foothills to the relatively flat San Joaquin Valley floor. The major streams in the county, the San Joaquin River, the Stanislaus River, and the Tuolumne River, originate high in the Sierra Nevada Mountains. Other streams in the county originate in the foothills of the Sierra Nevada and Coast Mountain range.

The Stanislaus and Tuolumne River and Dry Creek channels east of State Highway 99 are well entrenched below the San Joaquin Valley floor with well-defined floodplains. West of State Highway 99, the channels are not entrenched, and the floodplains of the Stanislaus River flows along the flat valley floor, with a wide and poorly defined floodplain.

Del Puerto, Salado, and Orestimba Creeks, in the west-central part of the county, have small channel capacities and very wide, undefined overflow areas that cause a downstream threat to the Cities of Patterson and Newman. Flooding is generally shallow, and areas of inundation are controlled primarily by road, railroad, and canal embankments. The terrain in this area slopes gently from the southwest to the northeast across the narrow valley portion of the three drainages and is relatively flat. Over an average distance of about 7 miles the elevation drops an average of 125 feet. The drainage basins of Del Puerto and Orestimba Creeks originate near the crest of the Diablo Range at about elevation 3,600 feet, and the headwaters of the Salado Creek drainage basin begin at about 2,600 feet.

The three streams studied flow through steep, mountain canyons in well-defined channels to the foothill line. Downstream of the foothill line much of the carrying capacity of the streams is reduced as a result of siltation and vegetative growth. They are all intermittent streams; the highest flows usually occur in late winter. Low flows during the remainder of the year are attributable to irrigation drainage. As previously mentioned, Del Puerto and Orestimba Creeks drain to the San Joaquin River, while Salado Creek terminates in the vicinity of the Southern Pacific Railroad (SPRR) tracks in Patterson. Pertinent information on these tributary drainage areas follows:

West-Side Tributary Drainage Areas*

Stream	Approximate Drainage Area Square Miles	Maximum Elevation of Watershed (Feet NGVD 29)
Orestimba Creek	134.0	3,600
Salado Creek	25.3	2,600
Del Puerto Creek	72.6	3,600

*Upstream from Interstate Highway 5

Four distinctly individual geographical features traverse the length of this area in a general northwesterly/southeasterly direction and in a mostly parallel fashion. These include from west to east: the Delta Mendota Canal (DMC), State Highway 33, the Southern Pacific Transportation Company (SPTC) railroad tracks, and the San Joaquin River. Generally paralleling the course of these four features just west of the study area are Interstate 5 and the California Aqueduct. The Main Canal traverses the southern or lower half of the study area in a southerly direction. Numerous laterals and canals, comprising a widespread water distribution system, crisscross the region and service the irrigation needs of the area farmers and ranchers.

The study area is served by Interstate 5, State Highways 33, 99, 120, and 140; and a network of county and city roads. Railroad services consist exclusively of freight transportation provided by the SPTC. Regional AMTRAK connections are available at the City of Riverbank via the Santa Fe Railway Company. Air service is provided mainly by the Modesto City-County Airport, the nearest basic transportation airport with regularly scheduled air carrier service. The Crows Landing Naval Air Station is located in the west-central part of the county. The Stockton Metropolitan Airport, with world-wide connections, is about 30 miles northwest of the City of Modesto. The deep-water port of Stockton provides access to overseas ports and markets.

There basically only two distinct seasons in the region; summer and winter. In the low valley areas, summers are long, hot, and dry, with very little precipitation. Winters are short and mild, with relatively light rainfall. Normal annual precipitation averages between 10 and 11 inches. Fog sometimes rolls in during winter months. In the tributary drainage basins in the Diablo Range to the west, summers are moderate to hot with little, if any, precipitation. Winters are short and mild with moderate rainfall; there is seldom any snowfall, and snowpack does not accumulate. The Normal Annual Precipitation averages more than 18 inches in the higher elevations of the drainage basins of Orestimba and Del Puerto Creeks. Almost all precipitation in the low valley and Diablo Range occurs between November and April.

Temperatures in the Patterson/Newman area range from average summer highs in the mid-90s to average winter lows in the high 30s. Summer temperatures exceeding 110˚F and winter temperatures below 27˚F can occur but are rare. In the Diablo Range, with a more moderate climate, temperatures in summer and winter are generally somewhat lower.

Much of the natural vegetation in the study area has been obliterated by agricultural operations and urbanization. There are some wild oats and other planted grasses, native annual grasses, various types of forbs and brush, marsh-type growth within the stream banks, and scattered oaks and willows along the streamways.

Vegetation on the eastern slope of the Diablo Range is characterized by small stands of pine, dense patches of chaparral, scattered oaks, and grasslands.

Soil types vary from previous riverine and alluvial fan soils to impervious soils in eastern parts of the county.

Most of Stanislaus County is agricultural land, with some residential and commercial development. Areas studied by detailed methods are at the outskirts of the incorporated cities, where residential, commercial, or industrial development has occurred or is planned.

2.3 Principal Flood Problems

Large floods occurred along the Stanislaus River in 1939, 1950, and 1955 before the New Melones Dam was constructed. Since the New Melones Dam and its related flood-control project were completed in 1979, floods of near record size have occurred in the San Joaquin Valley on the Stanislaus River in 1995, 1996, and 1997. The worst of these floods came in January of 1997. portions of the Towns of Ripon, Riverbank, and Oakdale were flooded. The New Melones Dam upstream of these cities on the Stanislaus provides a high level of protection, and the uncontrolled spillway of the dam did not spill during the January 1997 flood. However, large controlled outlet releases were required from the dam during these floods and affected a significant number of structures located in the floodplain.

Major damage resulted from the flood events of January 1997. The areas where flooding occurred have been identified as flood hazard mitigation projects areas. The large rainfall events that occurred in 1995, 1996, and 1997 shifted the flood frequency curves for the study reaches and significantly increased flood hazard areas.

Large floods occurred along the Stanislaus River in 1938, 1950, and 1955 before the New Melones Dam was constructed. Since construction of the New Melones Dam and its related flood control were completed in 1979, floods of near-record size have occurred in the San Joaquin Valley on the Stanislaus River in 1995, 1996, and 1997. The worse of these floods occurred in January 1997. Portions of the Cities of Ripon, Riverbank, and Oakdale were flooded. However, upstream of these cities, the New Melones Dam provided a high level of protection during the floods, and the uncontrolled spillway of the dam was not overtopped. In spite of this, large controlled outlet releases were required from the dam during the floods and affected a significant number of structures located in the floodplain.

Major flooding occurred in 1955 and 1969 on all the streams studied. Substantial flooding also occurred on several of the streams in 1950 (Reference 4), 1958 (Reference 5), 1963, 1964 (Reference 6), 1968, 1969, 1973 (Reference 7), 1978, 1980, 1983, and 1986. Most of the flood damage in Stanislaus County has been limited to agricultural land and crops, but with continuing encroachment on the floodplains by residential and commercial development, flood damage to structures and their contents is increasing.

Flooding in the Petterson/Newman area can occur anytime from October to April as a result of general rainstorms that originate over the Pacific Ocean. This type of flood results from prolonged heavy rainfall over tributary areas and is characterized by high peak flows of moderate duration and by a large volume of runoff. Flooding is more severe when antecedent rainfall has resulted in saturated ground conditions. The principal type of flooding in the study area is sheetflow; that is, broad, shallow, overland flooding generally less than 2 feet deep and characterized by unpredictable flowpaths.

General rainstorms over the region can produce flood conditions over a widespread area that, consequently, can cause either high flows on just one of the streams or concurrent high flows on two or all three of the streams.

The drainage areas for Del Puerto and Orestimba Creeks (upstream of Interstate 5) are 72.6 and 134 sq. mi., respectively.

Cloudburst storms are rare but can occur anytime from late spring to early fall, sometimes taking place in an extremely severe sequence within a general rainstorm. Cloudbursts are high intensity storms, yet in the vicinity of Patterson/Newman, they do not have the peak flows, duration, or volume of general rainstorms. Although they usually cover small areas, cloudburst storms can cause minor flooding on the comparatively flat valley floor in the county.

The flows for all three west-side streams are constricted at the DMC by either a siphon (Del Puerto and Orestimba Creeks) or an overchute (Salado Creek), thus forcing the ponding of floodwaters to the west of the canal. The Salado Creek ponding is diverted southeasterly for a few miles, and eventually, a substantial quantity of floodwaters flow into Little Salado Creek and then under the canal, adding significantly to floodflows in the vicinity of the Naval Auxiliary Landing Field just northwest of Crows Landing.

The peak discharge of Salado Creek through the City of Patterson is limited by the Salado Creek overchute capacity over the DMC. The overchute capacity is 710-cubic feet per second (cfs), which is approximately equal to the 2-percent annual chance recurrence interval flood on Salado Creek. The overchute was built in 1947 and is located approximately 3 miles upstream from Patterson.

Downstream from the overchute, the channel capacity of Salado Creek is approximately 300 cfs. During periods of high flow, overflow occurs along the banks of Salado Creekat several locations south-west and west of Patterson. The overflow does not return to the channel because there are small manmade levees along the channel, and the natural slope of the land surface is away from the channel. The overflow enters Patterson from the west as sheetflow, generally flowing from southwest to northeast.

The SPRR embankment through Patterson is approximately 3 feet higher than the land surface. Ponding occurs behind the embankment as the drainage structures are inadequate for the SPRR tracks.

The severity of flooding in the area is intensified by ponding conditions that can occur at various locations in the three basins. Overland flows caused by insufficient capacities of channels, culverts, and bridges result in substantial ponding of floodwaters, especially against obstructions such as levees and the embankments of county roads and the SPRR. The ponding floodwaters usually are deeper than the overland floodflows. The ponding either overtops the particular obstruction, is redirected along the obstruction, or remains until dissipated by seepage and evaporation.

Floodwater is directed southward through Newman by the railroad embankment. This floodwater ponds in the southeastern part of the city before overtopping the railroad and continuing eastward.

Floods in 1955, 1958, and 1980 have followed this flooding pattern, with shallow floodflows entering Newman from the north and west (References 8 and 9). There has been very little structural damage in Newman because flooding is shallow, with relatively slow velocities.

Flood conditions are further aggravated by the transition from steep, well-defined mountain channels to gently slopping valley floor streambeds with reduced carrying capacity because of both vegetation and silt.

Because of the rural nature of the study area, the relatively short period of streamflow records (records on Orestimba Creek were begun in 1932 and on Del Puerto Creek in 1959; Salado Creek does not have a gage), sparse newspaper accounts, and the scarcity of contemporary accounts of floods in the area, little definitive data are available for specific floods. Information on past floods is based essentially on historical accounts, various published and unpublished reports, and newspaper articles.

Flooding reportedly occurred in the Patterson/Newman area in 1954, 1955, 1957, 1958, 1959, 1963, 1968, 1969, 1978, 1980, 1983, and 1986. The largest flood of record occurred in April 1958 when a peak flow of 10,200 cubic feet per second (cfs) was recorded at the Newman Gage on Orestimba Creek. The most damaging flood was in February 1980 when almost $340,000 in damages occurred in the Orestimba Creek Basin alone, and the official estimate of the county’s west-side damage was approximately $1 million. Flooding occurred on all three creeks (Salado, Del Puerto, and Orestimba) in December 1955, February 1959, January 1969, and February 1980; on Salado and Orestimba Creeks in April 1958 and January 1983; on Orestimba Creek in February 1963; and on Salado Creek in March 1983.

The December 1955 floodwaters inundated agricultural, residential, and commercial properties; caused breaks in the DMC; washed out roads and culverts; inundated and closed roads in many areas; and washed out SPRR ballasts and ties.

The April 1958 flood mainly damaged agricultural facilities in the Orestimba Creek basin and public, commercial, and residential properties in the Salado Creek Basin. Residents in both basins were forced to evacuate their homes. Volunteers used about 5,000 sandbags in fighting the flood along Salado Creek.

During the February 1959 flooding, Orestimba Creek floodwaters eroded the west embankment of the Anderson Road Bridge, causing that end to drop 2 feet, which in turn caused several cracks in the bridge. Floodwaters from Del Puerto Creek washed out a canyon bridge west of Interstate 5 and felled many telephone poles and lines. Patterson reportedly received more than 2 inches of rain in a 24-hour period and needed pumps to drain flooded streets.

In early February 1963, about 6 inches of rain fell over the Orestimba Creek Basin, causing both flooding and the second largest peak flow on record. About 2,000 acres were covered by shallow floodwaters approximately 4 to 5 miles north of Newman. Farmland was eroded and had debris and silt deposited on it. The DMC siphon and approaches to both road and railroad bridges were eroded and required repair. The floodwaters throughout the area left debris that had to be removed.

Extensive rainfall in January 1969, 3 to 5 inches over the valley floor and 6 to 10 inches in the high elevations of the drainage basin-caused the flooding of nearly 2,000 acres. Most flood damage was to agricultural lands and mainly consisted of erosion of fields, deposition of sediment, and prolonged inundation that affected walnut orchards.

The February 1980 floodwaters caused the most severe damages ever recorded in the study area. Between 2,000 and 3,000 acres of farmland were inundated, and numerous county roads and city streets were flooded and closed. Residential and commercial areas were flooded, and fire, police, and public works crews in Patterson worked to prevent further damage there. A National Guard helicopter was used to position junk cars and sandbags within a 80-foot-long levee break on Salado Creek.

In early March 1983, a Salado Creek embankment southwest of Patterson gave way, and floodwaters also covered portions of State Highway 33 north of town, closed the road to traffic, and caused evacuations of some residents.

Low-lying areas of Modesto are subject to flooding when overflow from Dry Creek and Tuolumne River occurs. Flooding occurred along Dry Creek in 1955, 1958, 1969, and 1973.

Flooding along Tuolumne River results from winter rainfall during November through March and spring snowmelt during April through July. The snowmelt floods have comparatively low peaks, but have large volumes of water and are of long duration. The larger peak discharges are caused by rain, and occurred along Tuolumne River in 1950, 1955, and 1969. The largest of these floods was on December 9, 1950. Peak discharge of this flood was 57,000 cfs in Modesto, and 59,000 cfs in Waterford. Because of the flood control available from Don Pedro Dam, completed in 1970, the flood of December 9, 1950, now has a statistical recurrence interval of approximately 120 years.

Historically, most flood damage had been limited to agricultural land and crops; but with continuing encroachment on the flood plains by residential and commercial development, flood damage to structures and their contents has increased.

There are areas of Modesto that have dry wells to dispose of storm runoff. Dry wells are small in diameter and generally backfilled with smaller rock. Storm water storage is available in the dry wells as water is percolated into the ground. Intense or prolonged rainfall runoff generally exceeds the dry well capacities in several areas of Modesto. The flooding that results is generally less than 1 foot deep, in confined to streets and sidewalks, and has caused little or no structural damage.

Bridge openings at Waterford are large enough to pass floodflows with only slight backwater effects. There has been little damage from floods along the Tuolumne River because there is little development on the flood plain.

Shallow flooding, less than 1 foot deep, from local runoff occurs in Waterford during major rainstorms. This is due to limited topographic relief and inadequate storm drainage.

2.4 Flood Protection Measures

The Stanislaus River drainage is regulated by nine reservoirs and several diversions upstream of the New Melones dam site. The reservoirs are used for irrigation and production of hydroelectric power. Storage capacities range from 2,000 to 91,500 acre-feet (Reference 10).

New Melones Dam and Reservoir, located approximately 20 miles upstream of Oakdale, is a major, multiple-use water-resource product. Full-design flood control became available in November 1918. Maximum storage of New Melones Reservoir is 2.4 million acre-feet, with available flood storage of 450,000 acre-feet (Reference 10).

The main flood-control structure on the Tuolumne River is Don Pedro Dam and Don Pedro Lake, located in Tuolumne County, with a total storage volume of more than 2 million acre-feet and a flood storage capacity of 340,000 acre-feet. Don Pedro Dam was completed in 1970. Upstream of Don Pedro Dam are three reservoirs in the drainage basin: Lake Eleanor on Eleanor Creek (26,000 acre-feet), Hetchy Lake on the Tuolumne River (360,000 acre-feet), and Cherry lake on Cherry Creek (269,000 acre-feet). Since the completion of Don Pedro Dam, these three reservoirs no longer have allocated flood-control space, but normal operation procedures effectively control small and moderate floods and have considerable influence in reducing large rain and snowmelt floods (Reference 11).

Downstream of don Pedro Dam, Tuolumne River water is diverted by the Modesto Canal into Modesto Reservoir (27,000 acre-feet) and by the Turlock Canal into Turlock Lake (49,000 acre-feet). The combined capacity of these two canals is 4,000 cfs (Reference 12). The diversions reduce snowmelt floodflows, but winter diversions are small and have very little effect on large rain-caused floods.

Floodflows on the San Joaquin River in Stanislaus County are reduced by the flood storage on Millerton Lake, Lake McClure, aforementioned structures on the Stanislaus and Tuolumne Rivers, and substantial channel storage. Millerton Lake, behind Friant Dam on the San Joaquin River, has 390,000 acre-feet of storage allocated to flood control and began storing water in 1943. Lake McClure, behind New Exchequer Dam on the Merced River, has 400,000 acre-feet of storage allocated to flood control and began storing water in 1967 (Reference 12).

The San Joaquin River and the lower reaches of the Stanislaus and Tuolumne Rivers are leveed to contain floodflows. Most of these levees were constructed in the 1950s by the USACE. These levees are not continuous, especially on the west side of the San Joaquin River, and, in places, are not adequate to contain the 1-percent annual chance flood.

No Federal flood-control projects exist in the study area. However, some incidental storage exists behind embankments for roads, railroads, and water-conveyance systems.

Some intermittent embankment work and channel clearing has been performed by local interests, which is beneficial to the immediate area of work but could aggravate downstream flood problems by allowing more water to reach lower stream areas.

Most structures in Newman are built on pads slightly higher than the surrounding area. This helps prevent the shallow flooding from entering the structures.

There are small manmade levees (from 1 to 3 feet high) along the Salado Creek channel in Patterson, but the additional channel capacity is not sufficient to contain the maximum discharge of the Salado Creek overchute. The Patterson Department of Public Works conducts routine clearing of the channel, bridges, and culverts along Salado Creek.

The City of Patterson adopted the general Plan Program for land use regulations and planning.

One of the major causes of flooding in the Central California Valley communities has been failure of levees throughout the area (Reference 13). However, a 300-home subdivision built along the Stanislaus River in 1993 in Riverbank has been protected by a USACE levee constructed in 1950.

There are no flood protection measures for Dry Creek.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or 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 short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedance) in any 50-year period is approximately 40 percent (4 in 10), and, 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 county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the county.

Pre-countywide Analyses

For each community within Stanislaus County that had a previously printed FIS report, the hydrologic analyses described in those reports and are summarized below.

<u>City of Modesto</u>

The peak discharge-frequency relationship used in this study for Dry Creek was determined using a log-Pearson Type III frequency analysis. Data were obtained for 39 years of discharge (1939-1977) recorded at the Dry Creek gaging station, located just downstream from Claus Road, and operated by the California Department of Water Resources. A weighted skew based on the U.S. Water Resources Council Bulletin 17 was used (Reference 14). The peak discharge-frequency relationship developed for Dry Creek as part of the Don Pedro Lake study (Reference 11) was approximately 20 percent higher than the log-Pearson Type III results. The USACE has accepted the accuracy of the log-Pearson Type III results.

The discharges of the Tuolumne River for the 2-, 1-, and 0.2-percent chance recurrence interval floods were obtained from the Don Pedro Lake study (Reference 11). The 10-percent chance discharge of 9,000 cfs used in this FIS is higher than the 10-percent chance discharge of 6,300 cfs given in the Don Pedro Lake study. Analysis of inflow below Don Pedro Dam compared to drainage area, using the Dry Creek frequency analysis, yielded the higher discharge value. The USACE has accepted the accuracy of the higher discharge value. A gaging station at the 9th Street Bridge has been operated since 1940 by the USGS.

City of Newman

Peak discharge-drainage area relationships for Orestimba Creek are shown in Table 2, "Summary of Discharges".

City of Patterson

A flood hydrograph and peak flows for 1-percent annual chance flood for Salado Creek were based on rainfall-runoff computations and statistical analysis of synthetic rainstorms.

Although basin streamflow records have been maintained for many years, (on Orestimba Creek near Newman since 1932 and on Del Puerto Creek near Patterson since 1959) hydrographs for the peak flows of record were not available for this study. Procedures used included the unit hydrograph method of analysis (Reference 14) and a Generalized Computer Program Flood Hydrograph Package (Reference 15). Streamflow routings were based on storage-discharge relationships developed for areas along each stream.

Due to the high absence of maximum flow hydrographs, hourly hydrographs of high peak flows for the January 1983 storm over the basin and corresponding rainfall data from regional precipitation stations were used to synthetically develop the unit hydrograph for Del Puerto Creek. A unit hydrograph for Salado Creek was derived from a S-curve developed from the Del Puerto Creek unit hydrograph.

The capacity of the Salado Creek overchute over the Delta Mendota Canal limits the discharge of Salado Creek through Patterson (Reference 16). Duration of high flow based on the unit hydrograph was used to determine areas and depths of flooding in Patterson.

The capacity of the Salado Creek overchute over the Delta Mendota Canal is 710 cfs, which is much less than the 1-percent annual chance discharge of 2,400 cfs. Discharge in excess of the overchute capacity will overtop that Salado Creek levees and pond upstream of the Delta Mendota Canal. A discharge of 710 cfs, with duration based on the 1-percent annual chance flood hydrograph was routed through Patterson.

City of Riverbank

As a result of large rainfall events in 1995, 1996, and 1997, it was expected that a shift in the computed flood frequency peak flows had occurred that would increase flood hazard areas. As a result, a new flood flow frequency analysis (References 17 and 18) was performed as part of this study by the USACE, Sacramento District. Using all historical data (References 19 and 20) collected to date, peak river flows have been estimated for 10-, 2-, 1-, and 0.2-percent annual chance floods. This hydrology analysis is presented in the Rain Flood Flow Frequency Analysis Report of 1999 (Reference 21).

Peak discharges for the 10-, 2-, 1-, and 0.2- percent annual chance floods, used in the steady flow model, were based on updated hydrology. Flow data for the January 1997 flood event were estimated by DWR and the USGS. The peak discharge of 9,019 cfs from the 1997 flood was used for calibration of the steady-state hydraulic model. The flow data, recorded at gages at the Orange Blossom Bridge and State Highway 99 bridge at Ripon, indicated a period of approximately 15 hours of lag time for the flow routing from the Orange Blossom Bridge to the City of Ripon. The off-channel storage area along the Stanislaus River reduced the peak discharge in the downstream channel. The USGS gage at the State Highway 99 Bridge at Ripon indicated that the peak discharge leveled off at about 7,000 cfs. A more rigorous and refined calibration was used for this study. An hourly flow hydrograph was used in unsteady-state hydraulic model to replicate the flood of January 1997. The hydrograph was the actual recorded data of the gage at the Orange Blossom Bridge. Both steady-state and unsteady-state models indicated that the USACE Hydrologic Engineering Center-River Analysis System (HEC-RAS) model was able to accurately reproduce the flood of 1997 at locations with recorded high-water marks (Reference 22).

For a detailed explanation of the hydrologic information, please refer to the Rain Flood Flow Frequencies Analysis (Reference 21).

<u>Stanislaus County (Unincorporated Areas)</u>

The peak discharge-frequency relationships used for Stanislaus River are from the USACE design memorandums of the New Melones Project for conditions existing after the completion of New Melones Dam in November 1978 (References 10 and 23). The relations were developed using the USACE HEC-1 computer program (Reference 24), a rainfall-runoff modeling program with reservoir-routing capabilities.

The Tuolumne River discharges for the 2-, 1-, and 0.2-percent annual chance recurrence interval floods at the City of Modesto were based on those values determined in the Don Pedro Lake Study (Reference 11).

The discharge-frequency relation used in this study for Dry Creek was determined using a log-Pearson Type III frequency analysis with a weighted skew (Reference 14). The analysis was based on 39 years of discharge records (1939-1977) from Dry Creek near the Modesto gaging station, located downstream of Claus Road.

The peak discharge-frequency relationship for the Tuolumne River at Waterford was determined by interpolation between the relations given in the Don Pedro Lake Study at LeGrange and Modesto (Reference 11).

The 1-percent annual chance discharge for San Joaquin River used in this study was determined by the USACE (Reference 25).

Flood hydrographs and peak flows for the 1-percent annual chance flood for Del Puerto, Salado, and Orestimba Creeks were based on rainfall-runoff computations and statistical analysis of synthetic rainstorms.

Although basin streamflow records have been maintained for many years (on Orestimba Creek near Newman since 1932 and on Del Puerto Creek near Patterson since 1959), hydrographs for the peak flows of record were not available for this study. Procedures used included the unit hydrograph method of analysis and a generalized computer program flood hydrograph package (Reference 15). Streamflow routings were based on storage-discharge relationships developed for areas along each stream.

As a result of the absence of maximum flow hydrographs, hourly hydrographs of high peak flows for the January 1983 storm over the basin and corresponding rainfall data from regional precipitation stations were used to synthetically develop unit hydrographs for Orestimba and Del Puerto Creeks. A unit hydrograph for Salado Creek was derived from a S-curve developed from the Del Puerto Creek unit hydrograph.

Rainfall-runoff computations were based on precipitation-frequency data delivered from the National Oceanic and Atmospheric Administration (NOAA) Atlas 2 for California (Reference 26) and the unit hydrograph method of analysis.

It was determined that general rainstorms produce the most severe flood conditions in the basin. Subsequently, a specific 100-year, 24-hour general rainstorm was developed for each of the three stream basins studied. The DWR developed 24-hour precipitation-frequency curves for nearby climate stations. These curves compare closely with data in the NOAA Atlas 2 for California (Reference 26).

Loss-rate data for the 100-year storms on the three streams in the study area were derived from loss-rate data developed for a series of storms over Orestimba and Del Puerto Creeks in January 1983. The loss-rates were also based on the initial and constant loss concept and analyses of soil cover and land uses. Base flow included recession amounts from previous storms.

Applying the Flood Flow Frequency Analysis computer program (Reference 27) to the gaged streamflow data, peak flow frequency curves were developed for the stream gages on Orestimba and Del Puerto Creeks. The curves were used to authenticate the validity of the peak flows generated by the synthetic 100-year, 24-hour storms on the study area streams.

The updated hydrologic analysis from the September 30, 2004 FIS report are in agreement with the hydrologic analysis referenced for the City of Riverbank.

<u>City of Waterford</u>

The peak discharge-frequency relationship for the Tuolumne River at Waterford was obtained using relations from the study Don Pedro Lake-Reservoir Regulation for Flood Control (Reference 11). A gaging station at Hickman Bridge has been operated by the DWR since 1932. During some historical flooding, channel storage has effectively reduced peak discharges in the downstream direction. However, when large, sustained releases from upstream reservoirs occur, channel storage becomes ineffective and peak discharges increase in the downstream direction. Flood-frequency relations given in the aforementioned study at sites 16 miles upstream (below La Grange Dam) and 12 miles downstream (at Modesto) were interpolated to give peak discharges at Waterford.

For the approximate study of local rainfall, peak discharge and runoff volume were computed using the NOAA Precipitation-Frequency Atlas (Reference 26) and the U.S. Soil Conservation Service Urban Hydrology Manual (Reference 28).

This Countywide Analysis

No hydrologic analyses were carried out for this countywide FIS.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 2, "Summary of Discharges."

TABLE 2 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-percent annual chance	2-percent annual chance	1-percent annual chance	0.2-percent annual chance
DEL PUERTO CREEK					
At Interstate 5	72.6	*	*	7,960	*
DRY CREEK					
At Modesto	192.3	4,730	9,300	11,800	18,100
ORESTIMBA CREEK					
At Interstate 5	134.0	*	*	15,590	*
SALADO CREEK					
At Interstate 5	25.3	*	*	2,820	*
Below DMC	25.3	*	*	710	*
STANISLAUS RIVER					
At Oakdale	1,020	7,600	8,000	8,000	41,300
TUOLUMNE RIVER					
At Modesto	1,884	10,500	32,000	70,000	154,000
At Waterford	1,640	9,000	10,000	42,000	225,000

*Data Not Available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the 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. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections for the flooding sources studied by detailed methods were obtained from field surveys at bridges and other selected locations. All bridges, dams, 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 (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the revised FIRM (Exhibit 2).

The hydraulic analyses for this FIS 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.

Pre-countywide Analyses

For each community within Stanislaus County that had a previously printed FIS report, the hydraulic analyses described in those reports have been compiled and summarized below.

City of Modesto

Cross section data for Tuolumne River were obtained from an earlier survey for the study entitled “Determination of Channel Capacity of the Tuolumne River Downstream from LaGrange” (Reference 29). For computation of the 0.2-percent annual chance flood profile, several cross sections were extended on the basis of topographic maps at a scale of 1:24,000, with a contour interval of 5 feet (Reference 30). Cross sections for Dry Creek were surveyed during the summer of 1976. All bridges and hydraulically significant structures were surveyed.

Elevations for the 10-, 2-, 1-, and 0.2-percent annual chance flood discharges were computed for Dry Creek and Tuolumne River using the USGS computer program E-431 (Reference 31).

High-water marks on the La Loma Bridge and at the gaging station at Claus Road were used to verify computed water-surface elevations on Dry Creek. A surveyed high-water profile of the flood on January 27, 1969 (32,600 cfs), was used to verify computed water-surface elevations on Tuolumne River.

The Tuolumne River 0.2-percent annual chance discharge greatly exceeds the channel capacity in Modesto. Hydraulic data for areas outside of the Tuolumne River channel and floodplain are limited. It was agreed that the time and expense involved in obtaining such data was not justified, therefore, elevations for the 0.2-percent annual chance flood and the delineation of areas subject to inundation by the 0.2-percent annual chance flood are estimates based on engineering judgment and should be used accordingly.

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 areas of shallow flooding resulting from inadequate drainage were studied by approximate methods. The analysis was limited to mapping the shallow flooding areas based on information from the City Department of Public Works, newspaper accounts (Reference 32), and field inspection.

City of Newman

Slope-conveyance computations (Reference 33) based on field-surveyed cross sections and surveys of critical areas of Newman were used to determine areas and depths of flooding. Estimates from historical flooding (References 8 and 9) and storage routing procedures (Reference 31) were also used to determine flooding patterns in Newman.

Some structural data for bridges, culverts, and railroad trestles were obtained from Stanislaus County, the City of Newman, and the SPTC. A field reconnaissance was conducted to obtain additional data.

The floodplain boundaries of the overland flow were estimated on the basis of topography, location of embankments, and slope in conveyance calculations. The flows were routed through ponded areas using the reservoir storage method (Reference 34). Results were verified by newspaper accounts of historical flooding (References 8 and 9) and other studies (References 35 and 36).

City of Patterson

Results of this study indicate that flood hazards in Patterson for all selected recurrence interval floods are limited to sheetflow areas and shallow ponded areas (maximum depth is 3 feet); therefore, shallow flooding guidelines were used, and only the 1-percent annual chance flood was routed through Patterson.

Bankfull channel capacity of Salado Creek upstream of Patterson was determined by storage and routing methods (Reference 37). Structural data for bridges, culverts and railroad trestles were obtained from Stanislaus County, the City of Patterson, and the SPTC. Full hydraulic efficiency of the channel and structures was assumed for all computations. Overbank flooding will occur at several locations along Salado Creek, downstream of the DMC. Extensive topographic surveying was used to determine probable sheetflow patterns. The sheetflow through Patterson will pond behind State Highway 33 and the SPRR embankment.

Water-surface elevations (WSELs) were computed through the use of a USACE HEC-2 step-backwater computer program for flooding along Salado Creek (Reference 15). Starting water-surface elevations for the streams studied were developed by the slope-area method.

Cross sections for backwater analyses were located at close intervals upstream and downstream from bridges, culverts, and other hydraulically significant features in order to establish the backwater effect of such structures in areas presently urbanized or subject to development. Additional cross sections were located at other representative locations in the study area. Cross section data were taken from field surveys and supplemented with topographic maps (Reference 38). Some structural data for bridges, culverts, and railroad trestles were obtained from Stanislaus County, the City of Patterson, and the SPTC. A field reconnaissance was conducted to obtain additional data.

The floodplain boundaries of the overland flow were estimated on the basis of topography, location of embankments, and slope (in conveyance calculations). The flows were routed through ponded areas using the reservoir storage method. Results were verified by newspaper accounts of historical flooding (References 8 and 9) and other studies (Reference 36).

City of Riverbank

Water-surface profiles were computed for the 10-, 2-, 1-, and 0.2-percent annual chance flood events using the USACE steady flow HEC-RAS computer program (Reference 22). The HEC-RAS model was calibrated to the January 1997 flood event. Starting WSELs were based upon normal-depth assumptions, and composite “n” values for each cross section were used to define roughness in the model. One-dimensional steady flow data were developed for this restudy. The cross-sectional data produced by InRoads software from the digital terrain model were imported into HEC-RAS and used as the basic river geometry for the one-dimensional steady-flow hydraulic model for this study. Bridge geometry was based on as-built plans and survey information.

Cross-section surveys used in this restudy were provided by Ayres Associates (Reference 39). Results used in the analyses included the completed sounding survey of the channel floor conducted by boat in February 1999; a cross-section survey by Ground Point Station in 2000; a 1998 section survey produced by a contract with GeoTopo, Inc.; and linear interpolation between cross sections (Reference 1).

All cross sections, including bridges on the Stanislaus River, were used in the HEC-RAS model. Because of the length of the reaches, many interpolated cross sections were created between the major cross sections. The hydrographic survey break lines of these interpolated cross sections were interpolated from their upstream or downstream surveyed cross sections.

The starting WSELs at the downstream limit of study were computed using normal-depth calculation at River Mile (RM) 12. An energy slope of 0.00047 was used for computation of normal depth for each flow profile.

The highway and railroad bridges in the study reach were constructed at different times. Data for all bridges were provided by the California Department of Transportation, Division of Structures, and the Burlington Northern Santa Fe Railroad Company. Bridge data were converted to NGVD 29, where necessary, using engineering judgment and ground elevation data from topographic surveys performed in 1999 and 2000.

Channel cross-section survey information was then imported into the design file to help define the topology of the river channel. The data for each cross section were copied a short distance downstream of the original, and points of equal elevation were connected by break lines. Between two surveyed cross sections, the channel elevations were represented by three-dimensional polylines with interpolated elevations.

The computed WSEL for the 1- and 0.2-percent flood profiles was used to generate a three-dimensional water surface for each profile. Each water surface was then intersected with the already defined ground surface. The intersecting lines were plotted and used as an initial estimate of the extent of the 1- and 0.2-percent floodplain. Using these as a guide, the 1- and 0.2-percent floodplain boundaries were revised based on field visits and an understanding of the local hydraulics.

<u>Stanislaus County (Unincorporated Areas)</u>

Elevations for flooding along the Stanislaus River detailed study area from the City of Oakdale to Knights Ferry were determined using the USGS computer program E-431, Energy Balance Step-Backwater Analysis (Reference 31). Starting from the program were determined from rating extensions from surveyed high-water profiles. Cross-section data were taken from an SC survey in the fall of 1975. Computer water-surface profiles were checked against the June 3, 1975, discharge of 7,500 cfs (Reference 40).

Elevations for the 10-percent and 2-percent annual chance floods on the detailed study areas along the Tuolumne River at Modesto were taken from a USACE report (Reference 36). The elevations of the 1-percent and 0.2-percent annual chance floods were determined using computer program E-431 (Reference 31).

Starting WSELs for the 1-percent annual chance flood were derived from an extension of the rating curve taken for the surveyed high-water profile. The 0.2-percent starting WSEL was determined using the slope-conveyance method. Cross-section data were derived from a USGS report (Reference 29) and extended using topographic maps at a scale of 1:24,000 with a contour interval of 5 feet (Reference 41) for the 0.2-percent annual chance flood. The computed water-surface profiles were checked against the 32,600 cfs discharge of January 27, 1969, and also against the 57,000 cfs discharge of December 9, 1950 (Reference 36). The 0.2-percent profile and areas of inundation for the reach of the Tuolumne River at Modesto are estimates only. The discharge greatly exceeds the channel capacity, and the hydraulic characteristics of urban floodplains are difficult to predict.

WSELs for the 10-percent and 2-percent annual chance floods for the detailed study areas along the Tuolumne River at Waterford were taken from a USACE report (Reference 36). The 1-percent annual chance elevations were derived from an extension of the high-water profile. The 0.2-percent annual chance elevations were determined using the E-431 computer program (Reference 31). The starting WSEL for the 1-percent annual chance flood was derived from extending the rating curve of surveyed high-water marks. The 0.2-percent annual chance elevation was determined using the slope-conveyance method. Cross-section information was taken from a USGS report (Reference 29) and extended using topographic maps (Reference 41) for the 0.2-percent annual chance flood. Computed WSELs were verified from the elevation of the 38,600 cfs flood of January 26, 1969.

WSELs for the detailed study along Dry Creek at Modesto were determined using the E-431 computer program (Reference 31). Starting WSELs for the program were taken from elevations of the Tuolumne river at the confluence of Dry Creek. Cross sections were surveyed by the SC in the summer of 1976. Computed water-surface profiles were checked against high-water marks at the La Loma Avenue Bridge and at the Claus Road gage.

A USACE HEC-2 step-backwater computer program was used to compute WSELs for flooding along Del Puerto, Salado, and Orestimba Creeks (Reference 15). Starting WSELs for the three streams studied were developed by the slope-area method.

Cross sections for backwater analyses were located at close intervals upstream and downstream of bridges, culverts, and other hydraulically significant features to establish the backwater effect of such structures in areas presently urbanized or subject to development. Additional cross sections were located at other representative locations in the study area. Cross-section data were taken from field surveys and supplemented with topographic maps (Reference 41). Along some reaches, cross sections could not be obtained because some landowners refused the right of entry.

Some structural data for bridges, culverts, and railroad trestles were obtained from Stanislaus County, the Cities of Petterson and Newman, and the SPTC. A field reconnaissance was conducted to obtain additional data.

The floodplain boundaries of the overland flow were estimated on the basis of topography, location of embankments, and slope-in conveyance calculations. The flows were routed through ponded areas using the reservoir storage method (Reference 34). Results were verified by newspaper accounts of historical flooding (References 8 and 9) and other studies (References 35 and 36).

In approximate study areas, 1-percent annual chance flood elevations are based on available data. Data were checked for accuracy and applicability, and extrapolated when necessary. Results were verified by comparison with historical flooding.

Normal depths of the 1-percent annual chance profile, determined for the detailed study reaches of the Stanislaus River and Dry Creek, were applied to the approximate study reaches based on the similarity of the channel in the reaches.

Flood elevations for the San Joaquin River and the approximate study reaches of the Tuolumne River were developed using USGS reports (References 29 and 42). These elevations were transferred to topographic maps to show Base Flood Elevation (BFE) lines and to determine floodplain boundaries (Reference 41).

The updated hydraulic analysis from the September 30, 2004 FIS report are in agreement with the hydraulic analysis referenced for the City of Riverbank.

City of Waterford

Cross section data, including bridges, of the Tuolumne River were obtained from an earlier survey for the channel capacity report (Reference 29).

Elevations of 10-percent and 2-percent annual chance flood discharges for the Tuolumne River were obtained from the channel capacity report (Reference 29). Elevations of the 1-percent annual chance flood discharge (42,000 cfs) were determined at cross sections by rating extensions, based on the surveyed high-water elevations of the flood of January 26-27, 1969 (38,600 cfs).

For computation of the 0.2-percent annual chance flood profile, cross sections were extended on the basis of topographic maps at a scale of 1:24,000, with contour intervals of 5 and 10 feet (References 43 and 44). Elevations were computed using the USGS computer program E-431 (Reference 31).

The starting WSEL for the Tuolumne River was determined by the slope-conveyance method and checked by convergence tests.

For the areas of shallow flooding, local rainfall runoff was routed through Waterford using slope-conveyance at critical locations. Results indicate shallow flooding of less than 1 foot deep in north-western Waterford.

Roughness coefficients (Manning’s “n”) used in the hydraulic computations were chosen based on field inspection. Table 3, “Manning’s “n” Values,” provides a listing of roughness coefficients used in the models.

TABLE 3 – MANNING'S "n" VALUES

Stream	Channel "n"	Overbank "n"
Del Puerto Creek	0.030-0.075	0.030-0.050
Dry Creek	0.035-0.065	0.090
Orestimba Creek	0.030-0.075	0.030-0.050
Salado Creek	0.030-0.075	0.030-0.050
Stanislaus River	0.045-0.060	0.050-0.120
Tuolumne River at Modesto	0.035-0.055	0.090
Tuolumne River at Waterford	0.030-0.045	0.040-0.070

This Countywide Analysis

Some flood hazard information presented in prior FIRMs and in prior FIS reports for Stanislaus 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 Stanislaus 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 USACE, the local communities, and other organizations to compile a list of levees that exist within Stanislaus County. Table 4 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 4 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. Normal-depth calculations were used to estimate the base flood elevation if detailed topographic or representative cross section information was available. The remaining base flood elevations were estimated from effective FIRM maps. The 1-percent-annual-chance floodplain boundary was traced along the contour line representing the estimated base flood elevation. Topographic features such as highways, railroads, and high ground were used to refine approximate floodplain boundary limits. The 1-pecent annual chance peak flow and floodplain widths and depth (assumed at 1 foot) were used to ensure the floodplain boundary was not overly conservative.

3.3 Vertical Datum

All FISs 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 FISs and FIRMs was NGVD 29. With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

Table 4 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISION

Community	Flood Source	Levee Inventory Identification Number	USACE Levee	Community	Flood Source	Levee Inventory Identification Number	USACE Levee
Stanislaus County Unincorporated Areas	Delta-Mendota Canal	**248**	No	Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**134**	No
Stanislaus County Unincorporated Areas	Delta-Mendota Canal	**176**	No	Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**135**	No
Stanislaus County Unincorporated Areas	Delta-Mendota Canal	**177**	No	Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**136**	No
Stanislaus County Unincorporated Areas	Little Salado Creek	**157**	No	Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**138**	No
Stanislaus County Unincorporated Areas	Little Salado Creek	**158**	No	Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**139**	No
Stanislaus County Unincorporated Areas	Sacramento River	**109**	No	Stanislaus County Unincorporated Areas	Stanislaus River	**P17**	Yes
Stanislaus County Unincorporated Areas	San Joaquin River	**P20**	Yes	Stanislaus County Unincorporated Areas	Stanislaus River	**P18**	Yes
Stanislaus County Unincorporated Areas	San Joaquin River	**P19**	Yes	City of Riverbank	Stanislaus River	**P15**	No
Stanislaus County Unincorporated Areas	San Joaquin River	**P21**	Yes	Stanislaus County Unincorporated Areas	Stanislaus River	**P16**	No
Stanislaus County Unincorporated Areas	San Joaquin River	**P22**	Yes	Stanislaus County Unincorporated Areas	Stanislaus River	**P59**	No
Stanislaus County Unincorporated Areas	San Joaquin River	**P23**	Yes	Stanislaus County Unincorporated Areas	Stanislaus River	**P179**	No
Stanislaus County Unincorporated Areas	San Joaquin River	**224**	No	Stanislaus County Unincorporated Areas	Stanislaus River	**89**	No
Stanislaus County Unincorporated Areas	San Joaquin River	**P24**	Yes	Stanislaus County Unincorporated Areas	Unknown	**85**	No
Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**130**	No	Stanislaus County Unincorporated Areas	Unknown	**140**	No
Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**131**	No	Stanislaus County Unincorporated Areas	Westley Wasteway	**P161**	No
Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**132**	No	Stanislaus County Unincorporated Areas	Westley Wasteway	**128**	No
Stanislaus County Unincorporated Areas	Sewage Disposal Pond	**133**	No	Stanislaus County Unincorporated Areas	Westport Drain	**137**	No

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the county must, therefore, be referenced to NAVD 88. It is important to note that adjacent counties may be referenced to NGVD 29. This may result in differences in base flood elevations (BFEs) across the county boundaries.

Prior versions of the FIS report and FIRM were referenced to NGVD 29. When datum conversion is effected for an FIS report and FIRM, the flood profiles and BFEs, reflect the new datum values. To compare structure and ground elevations to 1-percent annual chance flood elevations shown in the FIS and on the FIRM, the subject structure and ground elevations must be referenced to the new datum values.

The conversion from NGVD 29 to NAVD 88 ranged between +2.41 and +2.47 for this community. Accordingly, due to the statistically significant range in conversion factors, an average conversion factor could not be established for the entire community. The elevations shown in the FIS report and on the FIRM were, therefore, converted to NAVD88 using a stream-by-stream approach. In this method, an average conversion was established for each flooding source and applied accordingly. The conversion factor for each flooding source in the community may be found in Table 5, "Vertical Datum Conversions," as well as on the FIRM.

TABLE 5 – VERTICAL DATUM CONVERSIONS

Stream	Conv. Factor (ft)
Del Puerto Creek	+2.45
Dry Creek	+2.41
Orestimba Creek	+2.46
Salado Creek	+2.47
Stanislaus River	+2.41
Tuolumne Rive (At Modesto)	+2.41
Tuolumne River (At Waterford)	+2.41

The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 102.4 will appear as 102 on the FIRM and 102.6 will appear as 103. Therefore, users that wish to convert the elevations in this FIS to NGVD 29 should apply the stated conversion factor(s) to elevations shown on the Flood Profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

For more information regarding conversion between the NGVD 29 and NAVD 88, visit the National Geodetic Survey website at www.ngs.noss.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 Spring, Maryland 20910-3282
(310) 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 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 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 Elevations table. 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 flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 1-percent and 0.2-percent annual chance floodplains have been delineated using the flood elevations determined at each cross section.

The 1-percent and 0.2-percent annual chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, and AO), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent and 0.5-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM (Exhibit 2).

For this countywide FIS, floodplain boundaries were taken from the previously printed FIS and FIRMs for each community except areas that were redeleniated based on approximate analyses of behind levee flooding.

For the City of Modesto, between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of 5 feet (Reference 30). Approximate flood boundaries were delineated using information form the City Department of Public Works, field inspection, and newspaper accounts (Reference 32).

For the City of Newman, between cross sections, the boundaries were interpolated at a scale of 1:24,000, with a contour interval of 5 feet (Reference 45).

For the City of Patterson, between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000, with contour intervals of 5 and 20 feet (Reference 38).

For the City of Riverbank an extensive overbank survey was conducted in the study reach by the USACE for the Sacramento and San Joaquin Rivers Comprehensive Study. This detailed 2-foot contour digital terrain survey was conducted by Ayres Associates. It covers RM 0 to RM 48 of the Stanislaus River. The survey horizontal datum is referenced to the California State Coordinate System, North American Datum of 1983, CA Zone III. An aerial image of the entire study reach was also available through the above-referenced contract. It was used for the floodplain delineation process.

Aerial photographs taken during the January 1997 flood peak were obtained from Radman Aerial Survey Company, under a contract with the USACE and DWR. The photos were taken during the peak flow hour on January 13, 1997, and accurately reflect the floodplain boundary for the January 1997 flood. The photographs were used to help calibrate the model for this hydraulic analysis. The primary elevation data for the three-dimensional terrain model were obtained from an orthophoto overbank survey from Ayres Associates.

Using InRoads, a composite Digital Terrain Model was produced by merging the channel geometry into the overbank geometry. After defining channel alignment and a set of cross-section lines, InRoads extracted cross-section information based on the composite terrain model and exported georeferenced cross sections in HEC-RAS Geographic Information Systems format (*.geo).

For the Unincorporated Areas of Stanislaus County , between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of 5, 10, and 20 feet (Reference 41) and quadrangle maps enlarged to a scale of 1:12,000.

Determination of floodplain boundaries along the detailed-study reach of the Stanislaus River was aided by aerial photographs of the June 1975 high water at a scale of 1:72,000 (Reference 46).

In some approximate study areas, floodplain boundaries were estimated using topographic maps (Reference 41).

The Stanislaus River floodplain boundaries were coordinated with those determined by the USACE for the San Joaquin County FIS (Reference 47). The limits of the flooding in the approximate study areas of Dry Creek upstream of Claus Road were taken from the USGS Flood-Prone Area Map (Reference 48).

For the City of Waterford, between cross sections, the boundaries were interpolated at a scale of 1:24,000, with contour intervals of 5 and 10 feet (References 43 and 44).

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 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS 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 in Table 6, “Floodway Data.” The computed floodways are shown on the FIRM (Exhibit 2). 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 floodwaters 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 6, "Floodway Data." 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 the floodway.

Near the mouths of streams studied in detailed, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, “Without Floodway” elevations presented in Table 6 for certain downstream cross

FLOODING SOURCE		FLOODWAY			BASE 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
Del Puerto Creek								
A-K[1]								
I	30,820[2]	162	1,038	7.6	164.4	164.4	165.4	1.0
J	33,640[2]	195	1,260	6.2	174.6	174.6	175.6	1.0
K	34,500[2]	102	628	12.5	180.6	180.6	180.9	0.3
Dry Creek								
A	1,720[3]	474	4,539	2.6	76.4	64.7[4]	65.7	1.0
B	2,750[3]	186	2,622	4.5	76.4	64.9[4]	65.9	1.0
C	3,850[3]	119	1,851	6.4	76.4	65.3[4]	66.3	1.0
D	4,050[3]	131	2,132	5.5	76.4	66.3[4]	67.1	0.8
E	4,200[3]	96	1,960	6.0	76.4	66.4[4]	67.3	0.9
F	4,400[3]	130	1,706	6.9	76.4	66.5[4]	67.3	0.8
G	5,175[3]	116	2,042	5.8	76.4	67.8[4]	68.5	0.7
H	6,460[3]	128	2,130	5.5	76.4	68.8[4]	69.4	0.6
I	6,600[3]	127	2,132	5.5	76.4	69.1[4]	69.8	0.7
J	6,730[3]	229	3,024	3.9	76.4	69.6[4]	70.2	0.6
K	8,400[3]	268	2,764	4.3	76.4	70.6[4]	71.3	0.7
L	10,000[3]	287	2,878	4.1	76.4	72.0[4]	72.8	0.8
M	11,200[3]	269	3,135	3.8	76.4	72.9[4]	73.8	0.9
N	12,600[3]	298	2,216	5.3	76.4	74.5[4]	75.4	0.9
O	14,200[3]	313	2,758	4.3	77.0	76.7[4]	77.7	1.0
P	26,500[3]	140	2,194	5.4	78.0	78.0	79.0	1.0
Q	15,600[3]	394	2,470	4.8	79.2	79.2	79.9	0.7
R	17,075[3]	400	2,879	4.1	81.2	81.2	82.1	0.9
S	18,300[3]	226	2,195	5.4	82.4	82.4	83.3	0.9
T	19,400[3]	283	2,865	4.1	83.5	83.5	84.5	1.0
U	21,000[3]	279	2,884	4.1	84.7	84.7	85.7	1.0
V	21,975[3]	293	3,250	3.6	85.6	85.6	86.5	0.9

[1] No floodway computed
[2] Feet above confluence with San Joaquin River
[3] Feet above mouth
[4] Water-surface elevation computed without consideration of backwater effects of Tuolumne River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

DEL PUERTO CREEK – DRY CREEK

FLOODING SOURCE		FLOODWAY			BASE 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
Dry Creek (continued)								
W	22,920[2]	283	2,936	4.0	86.3	86.3	87.3	1.0
X	24,500[2]	255	3,011	3.9	88.0	88.0	88.9	0.9
Y	25,520[2]	294	3,143	3.8	89.1	89.1	90.0	0.9
Z	26,420[2]	230	3,397	3.5	90.1	90.1	91.1	1.0
AA	27,520[2]	734	6,691	1.8	90.9	90.9	91.9	1.0
AB	28,420[2]	425	4,238	2.8	91.3	91.3	92.3	1.0
AC	29,675[2]	172	2,516	4.7	92.2	92.2	93.2	1.0
AD	29,900[2]	438	4,651	2.5	92.9	92.9	93.8	0.9
Orestimba Creek								
A-N[1]								
O	49,790[3]	560	3,238	4.1	135.5	135.5	136.5	1.0
P	53,760[3]	503	2,386	6.1	140.7	140.7	141.3	0.6
Q	57,490[3]	414	3,193	4.7	149.4	149.4	150.4	1.0
R	59,750[3]	275	1,784	8.8	156.5	156.5	156.5	0.0
S	61,680[3]	148	1,593	10.2	166.2	166.2	167.2	1.0
T	62,200[3]	335	5,259	3.1	168.4	168.4	169.3	0.9

[1]No floodway computed
[2]Feet above mouth
[3]Feet above confluence with San Joaquin River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

DRY CREEK – ORESTIMBA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Stanislaus River								
A-W[1]								
X	252,220	140	2,278	3.5	135.3	135.3	135.8	0.5
Y	254,780	102	1,391	5.8	136.8	136.8	137.2	0.4
Z	258,010	183	2,599	3.1	139.1	139.1	139.6	0.5
AA	259,490	303	3,327	2.4	140.3	140.3	140.8	0.5
AB	261,560	209	1,796	4.5	142.4	142.4	142.9	0.5
AC	263,760	390	2,082	3.8	145.1	145.1	146.0	0.9
AD	265,320	221	2,108	3.8	146.9	146.9	147.7	0.8
AE	266,860	275	2,366	3.4	148.3	148.3	148.9	0.6
AF	268,730	97	1,141	7.0	150.0	150.0	150.5	0.5
AG	270,150	136	1,400	5.7	152.6	152.6	152.9	0.3
AH	272,400	309	3,325	2.4	155.0	155.0	155.3	0.3
AI	274,770	152	1,350	5.9	156.8	156.8	157.2	0.4
AJ	276,690	230	1,973	4.1	159.0	159.0	159.6	0.6
AK	277,440	166	1,614	5.0	159.7	159.7	160.3	0.6
AL	278,920	204	1,737	4.6	161.6	161.6	162.1	0.5
AM	280,320	241	1,986	4.0	162.5	162.5	163.1	0.6
AN	282,360	199	1,928	4.2	165.7	165.7	166.0	0.3
AO	283,990	150	1,753	4.6	167.3	167.3	167.6	0.3
AP	284,870	123	1,873	4.3	168.2	168.2	168.6	0.4
AQ	287,090	159	1,403	5.7	171.5	171.5	172.0	0.5
AR	288,560	266	1,984	4.0	174.4	174.4	175.3	0.9
AS	290,180	106	1,539	5.2	177.6	177.6	178.5	0.9
AT	291,280	158	1,514	5.3	179.3	179.3	180.1	0.8
AU	291,600	142	1,738	4.6	179.8	179.8	180.7	0.9

[1]No floodway computed
[2]Feet above mouth

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

STANISLAUS RIVER

FLOODING SOURCE		FLOODWAY			BASE 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
Tuolumne River at Modesto								
A	45,960	2,468	32,285	2.2	57.1	57.1	58.1	1.0
B	47,818	2,787	32,176	2.2	57.3	57.3	58.3	1.0
C	49,049	2,234	20,658	3.4	57.3	57.3	58.3	1.0
D	50,314	2,662	22,499	3.1	57.9	57.9	58.8	0.9
E	51,552	2,980	26,827	2.6	58.4	58.4	59.4	1.0
F	52,805	2,036	19,307	3.6	58.8	58.8	59.7	0.9
G	54,074	1,636	18,857	3.7	59.3	59.3	60.3	1.0
H	55,156	1,592	19,648	3.6	59.8	59.8	60.8	1.0
I	56,130	941	13,642	5.1	59.9	59.9	60.9	1.0
J	56,834	926	14,263	4.9	60.3	60.3	61.3	1.0
K	57,443	906	13,602	5.2	60.6	60.6	61.6	1.0
L	58,053	569	11,057	6.3	60.8	60.8	61.8	1.0
M	58,921	500	10,537	6.6	61.2	61.2	62.2	1.0
N	59,495	585	10,921	6.4	61.6	61.6	62.6	1.0
O	60,919	617	11,951	5.9	62.6	62.6	63.5	0.9
P	61,725	797	13,054	5.4	63.1	63.1	64.0	0.9
Q	62,678	851	13,287	5.3	63.7	63.7	64.6	0.9
R	63,640	481	10,007	7.0	64.1	64.1	64.9	0.8
S	64,298	595	10,946	6.4	64.7	64.7	65.4	0.7
T	65,616	516	10,784	6.5	65.5	65.5	66.1	0.6
U	66,437	546	9,039	7.7	66.0	66.0	66.6	0.6
V	67,428	393	8,243	8.5	66.9	66.9	67.5	0.6
W	68,132	605	12,706	6.1	68.1	68.1	68.7	0.6
X	69,495	1,089	18,917	4.3	68.6	68.6	69.3	0.7
Y	70,506	1,059	17,698	4.0	69.0	69.0	69.7	0.7
Z	71,437	644	13,351	5.2	69.4	69.4	70.0	0.6
AA	72,560	854	18,780	3.7	70.0	70.0	70.8	0.8

[1]Feet above mouth

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

TUOLUMNE RIVER AT MODESTO

FLOODING SOURCE		FLOODWAY			BASE 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
Tuolumne River at Modesto (continued)								
AB	73,605	546	12,640	5.8	70.1	70.1	70.9	0.8
AC	74,656	535	16,299	6.1	70.3	70.3	71.0	0.7
AD	76,017	996	18,212	3.8	71.8	71.8	72.4	0.6
AE	76,995	1,054	17,776	3.9	72.2	72.2	72.8	0.6
AF	78,083	1,016	17,772	3.9	72.4	72.4	73.1	0.7
AG	78,845	1,055	19,863	3.5	72.7	72.7	73.5	0.8
AH	80,817	508	12,398	5.7	73.3	73.3	74.2	0.9
AI	84,282	1,336	22,241	3.2	75.3	75.3	76.2	0.9
AJ	84,682	1,399	23,688	3.0	75.6	75.6	76.5	0.9
AK	85,855	1,958	32,242	2.2	76.1	76.1	77.0	0.9
AL	86,367	1,599	29,233	2.4	76.3	76.3	77.1	0.8
AM	87,200	1,862	40,099	4.3	76.4	76.4	77.2	0.8
AN	88,795	643	17,482	3.9	77.0	77.0	77.8	0.8
AO	89,667	780	17,282	3.9	77.2	77.2	77.9	0.7
AP	91,441	1,441	28,401	2.4	77.6	77.6	78.4	0.8
AQ	92,647	982	20,129	3.4	77.7	77.7	78.4	0.7
AR	93,818	671	15,042	4.5	77.8	77.8	78.6	0.8
AS	94,871	672	15,833	4.3	78.1	78.1	78.9	0.8
AT	95,755	685	17,137	3.9	78.4	78.4	79.2	0.8
AU	96,806	974	20,133	3.4	78.6	78.6	79.5	0.9
AV	97,691	1,002	20,095	3.4	78.9	78.9	79.7	0.8
AW	99,213	1,218	28,472	2.4	79.4	79.4	80.1	0.7
AX	100,711	1,460	25,016	2.7	79.6	79.6	80.3	0.7
AY	101,449	1,032	25,306	2.7	79.9	79.9	80.6	0.7
AZ	103,405	2,646	58,448	1.2	80.6	80.6	81.3	0.7
BA	104,230	2,757	59,346	1.1	80.6	80.6	81.3	0.7
BB	106,185	3,336	67,334	1.0	80.7	80.7	81.4	0.7

[1]Feet above mouth

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

TUOLUMNE RIVER AT MODESTO

FLOODING SOURCE		FLOODWAY			BASE 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
Tuolumne River at Modesto (continued)								
BC	108,496	2,378	39,056	1.7	80.7	80.7	81.4	0.7
BD	109,746	2,445	38,351	1.8	80.9	80.9	81.5	0.6
BE	110,817	2,586	45,234	1.5	81.0	81.0	81.7	0.7
BF	112,498	2,136	35,697	1.9	81.1	81.1	81.8	0.7
BG	114,069	1,305	24,223	2.8	81.2	81.2	81.9	0.7
BH	115,401	926	19,314	3.5	81.4	81.4	82.1	0.7
BI	116,871	379	10,648	6.3	82.0	82.0	82.5	0.5
BJ	118,106	859	17,894	3.8	82.5	82.5	83.1	0.6
BK	120,993	1,429	34,333	2.0	83.2	83.2	83.9	0.7
BL	123,843	820	17,681	3.8	83.6	83.6	84.3	0.7

[1]Feet above mouth

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

TUOLUMNE RIVER AT MODESTO

sections of Dry Creek are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

Hazardous velocities (greater than 6-7 feet per second) would be produced from encroachment on the Tuolumne River channel at Waterford; therefore, the entire area inundated by the 1-percent annual chance flood is included in the floodway.

A floodway was not developed for Salado Creek because of overflow losses. These cannot be confined by a floodway without causing additional flooding downstream.

Along streams where floodways have not been computed, the community must ensure that the cumulative effect of development in the floodplains will not cause more than a 1.0-foot increase in the BFEs at any point within the community.

The area between the floodway and 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."

5.0 INSURANCE APPLICATIONS

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

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance risk zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are

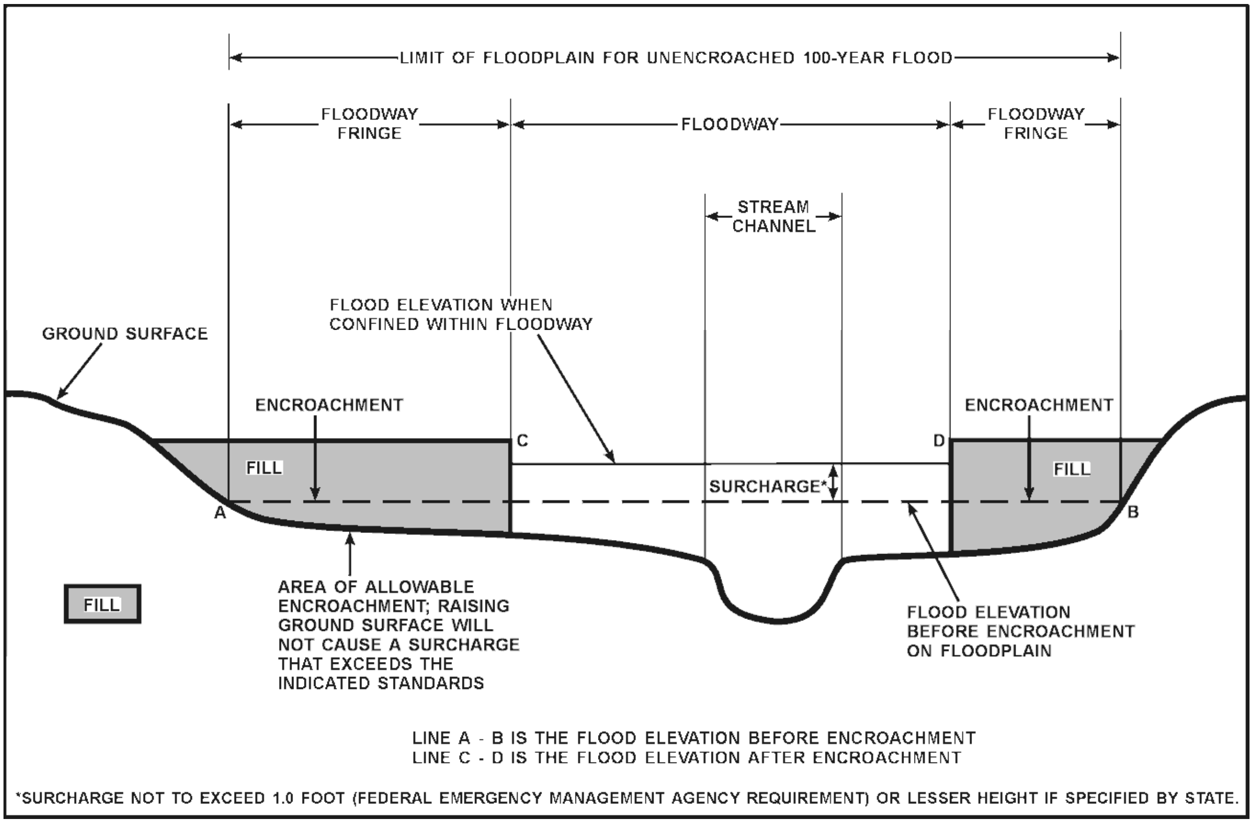

Figure 1: FLOODWAY SCHEMATIC

between 1 and 3 feet. Whole-foot BFEs 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 shown 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, and 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 BFEs or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

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

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and shows selected whole-foot BFEs or average depths in the 1-percent annual chance floodplains that were studied by detailed methods. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map uses tints, screens, and symbols to show the 1-percent and 0.2-percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Stanislaus County. Previously, separate FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community, up to and including this countywide FIS, are presented in Table 7, "Community Map History."

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Stanislaus County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS reports, FIRMs, and/or FBFMs for all of the incorporated and unincorporated jurisdictions within Stanislaus County (References 49, 50, 51, 52, 53, and 54).

8.0 LOCATION OF DATA

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

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COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Ceres, City of	September 26, 2008	None	September 26, 2008	
Hughson, City of	September 26, 2008	None	September 26, 2008	
Modesto, City of	July 19, 1974	August 15, 1975	August 15, 1980	August 17, 1982 May 7, 2001 September 26, 2008
Newman, City of	February 7, 1975	None	September 29, 1978	January 3, 1990 September 26, 2008
Oakdale, City of	June 7, 1974	December 12, 1975	September 5, 1979	September 30, 2004 September 26, 2008
Patterson, City of	May 3, 1974	September 26, 1975	August 1, 1979	November 10, 1981 January 3, 1990 September 26, 2008
Riverbank, City of	September 30, 2004	None	September 30, 2004	September 26, 2008

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**STANISLAUS COUNTY, CA
AND INCORPORATED AREAS**

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Stanislaus County (Unincorporated Areas)	August 1, 1980	None	August 1, 1980	October 16, 1984 September 29, 1989 May 7, 2001 September 30,2004 September 26, 2008
*Turlock, City of	N/A	N/A	N/A	
Waterford, City of	May 24, 1974	October 17, 1975	July 16, 1979	

*Non Flood-Prone Community

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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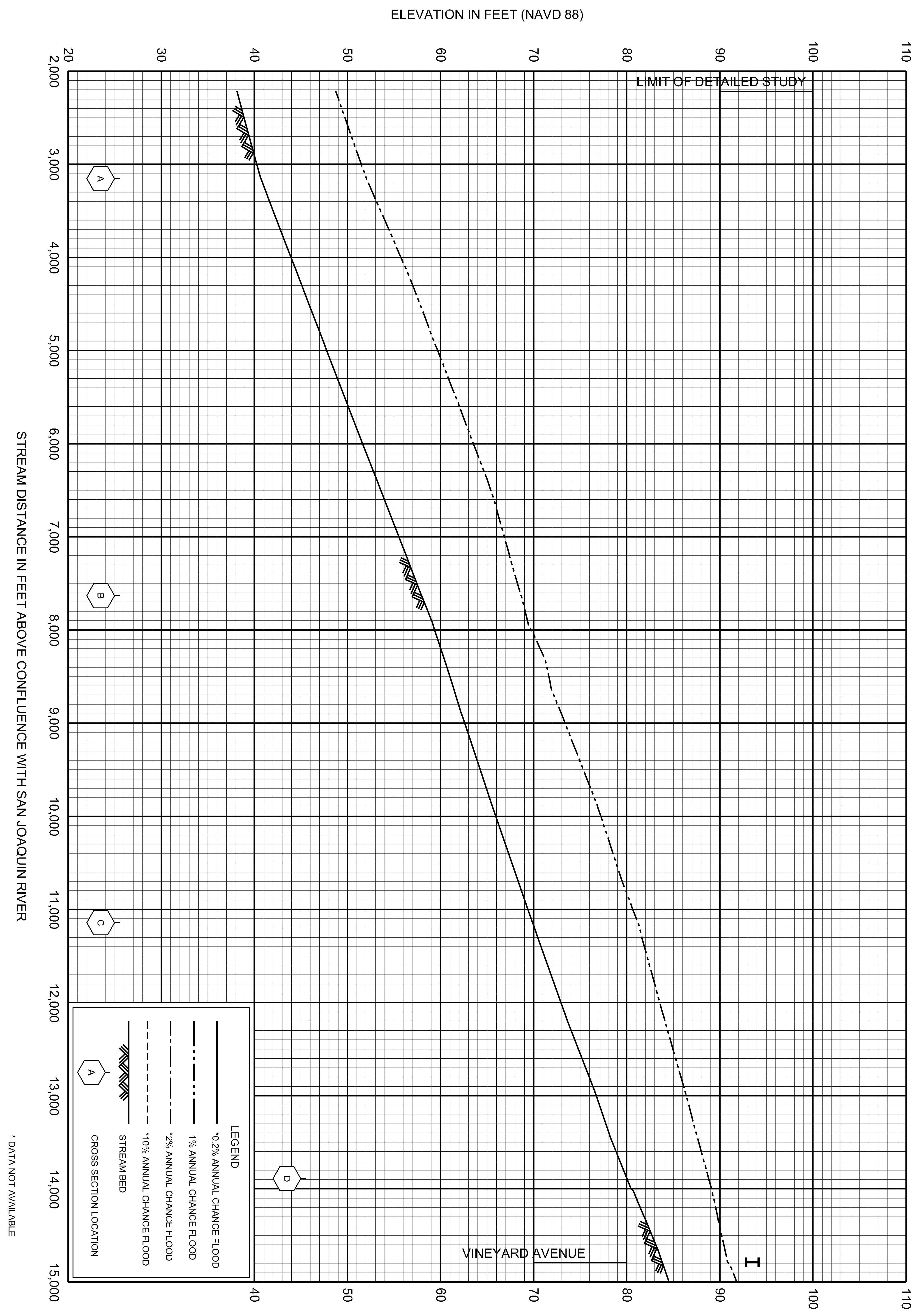

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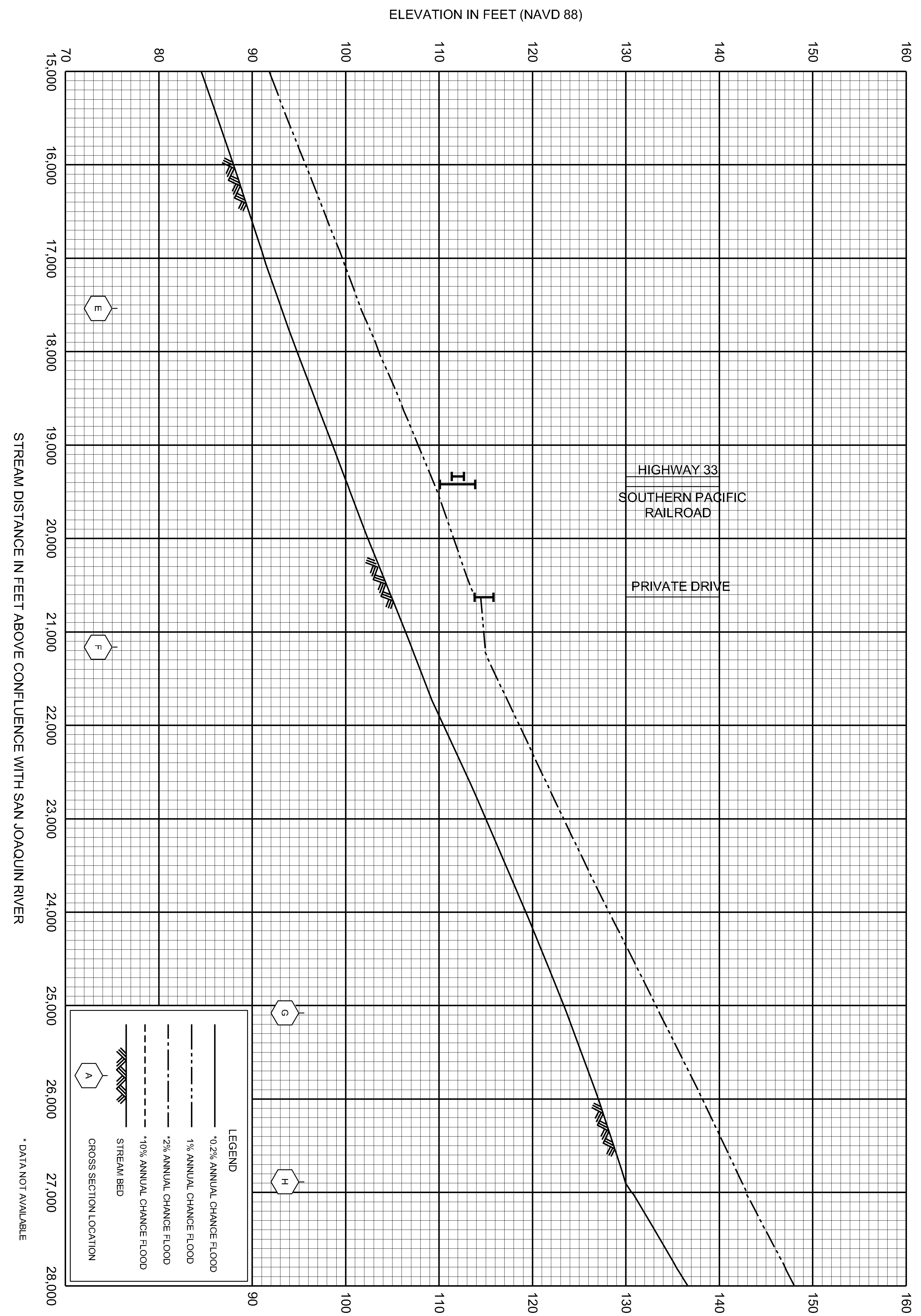
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

DEL PUERTO CREEK



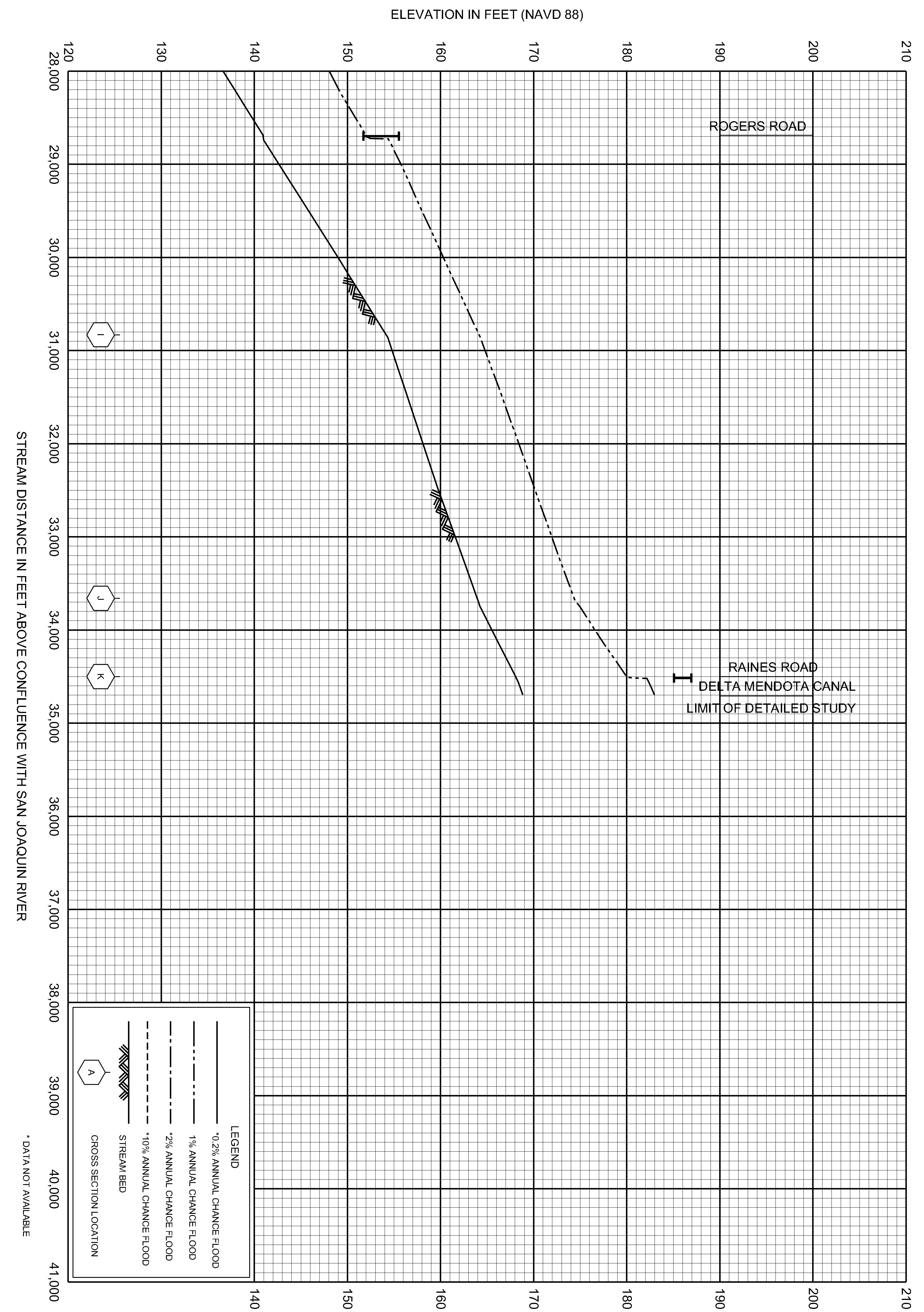
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

DEL PUERTO CREEK



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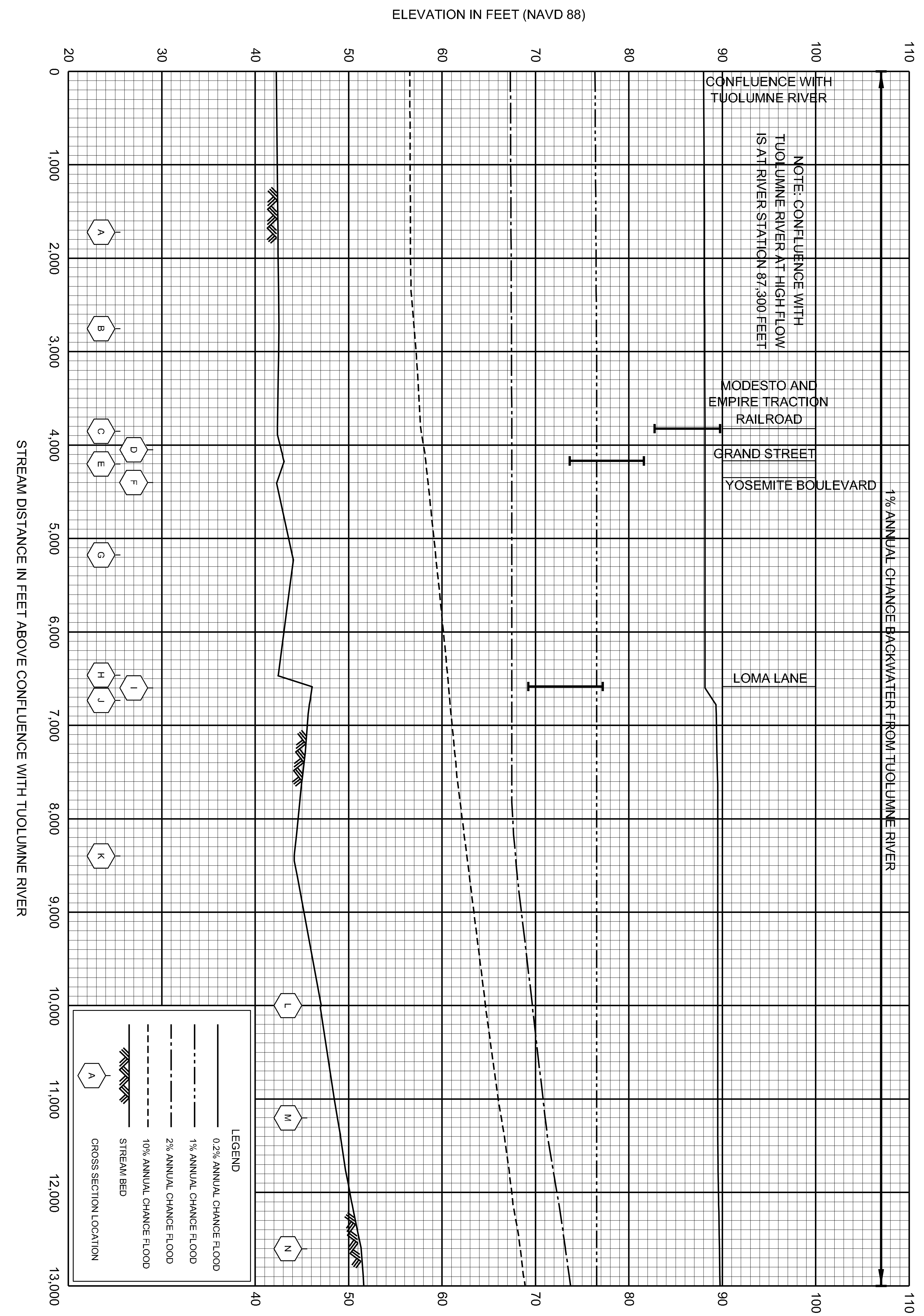
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

DEL PUERTO CREEK



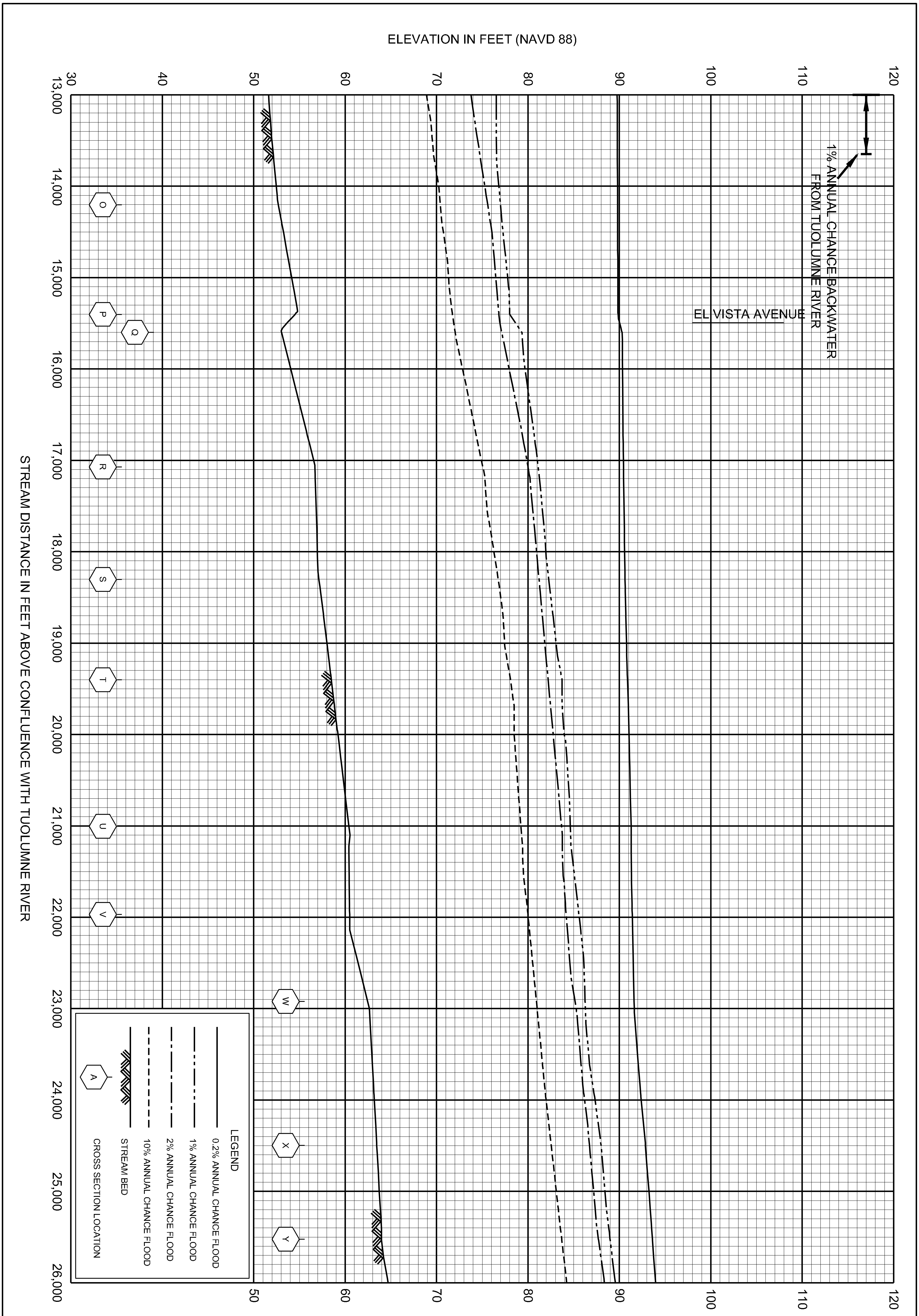
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

DRY CREEK



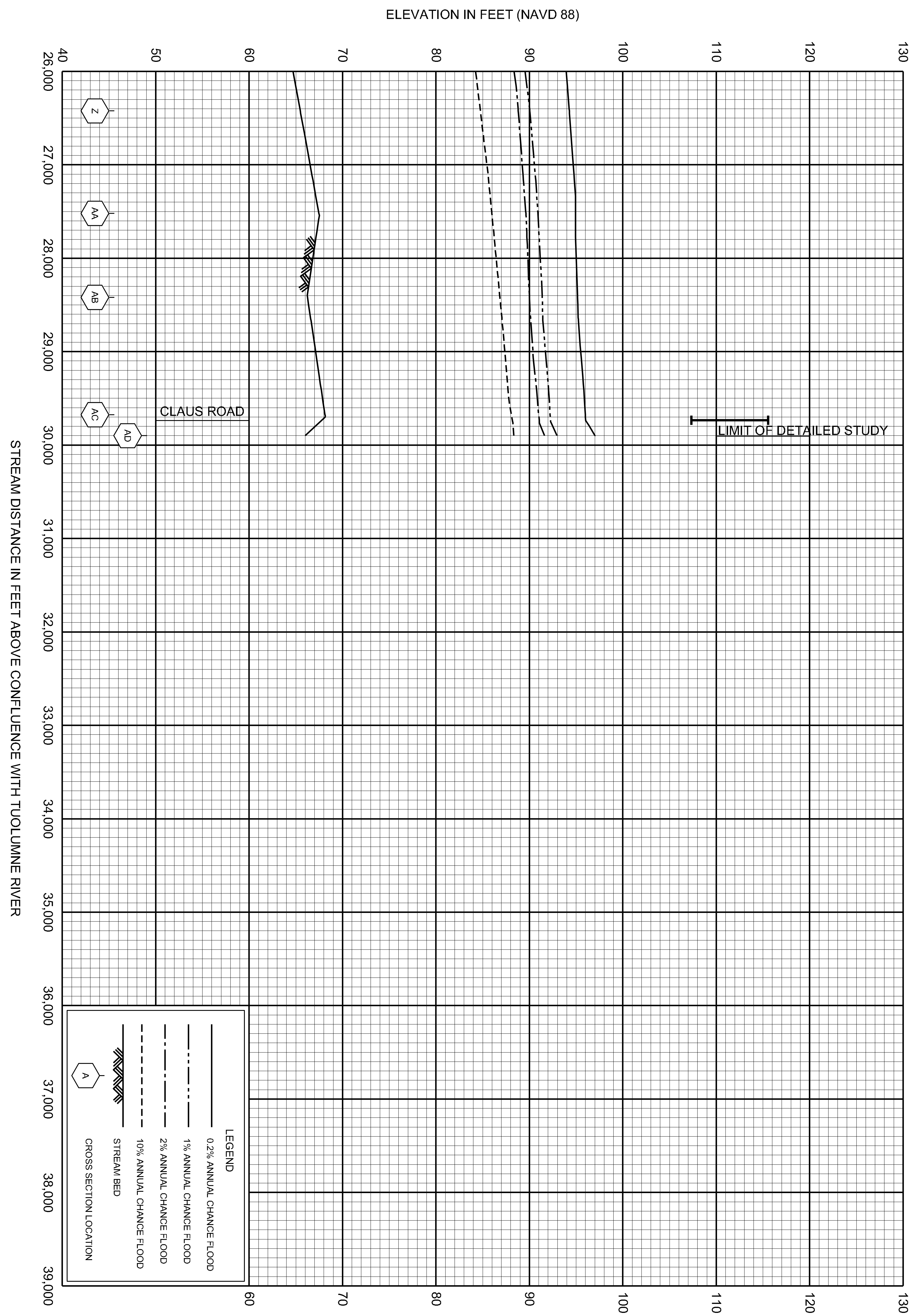
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

DRY CREEK



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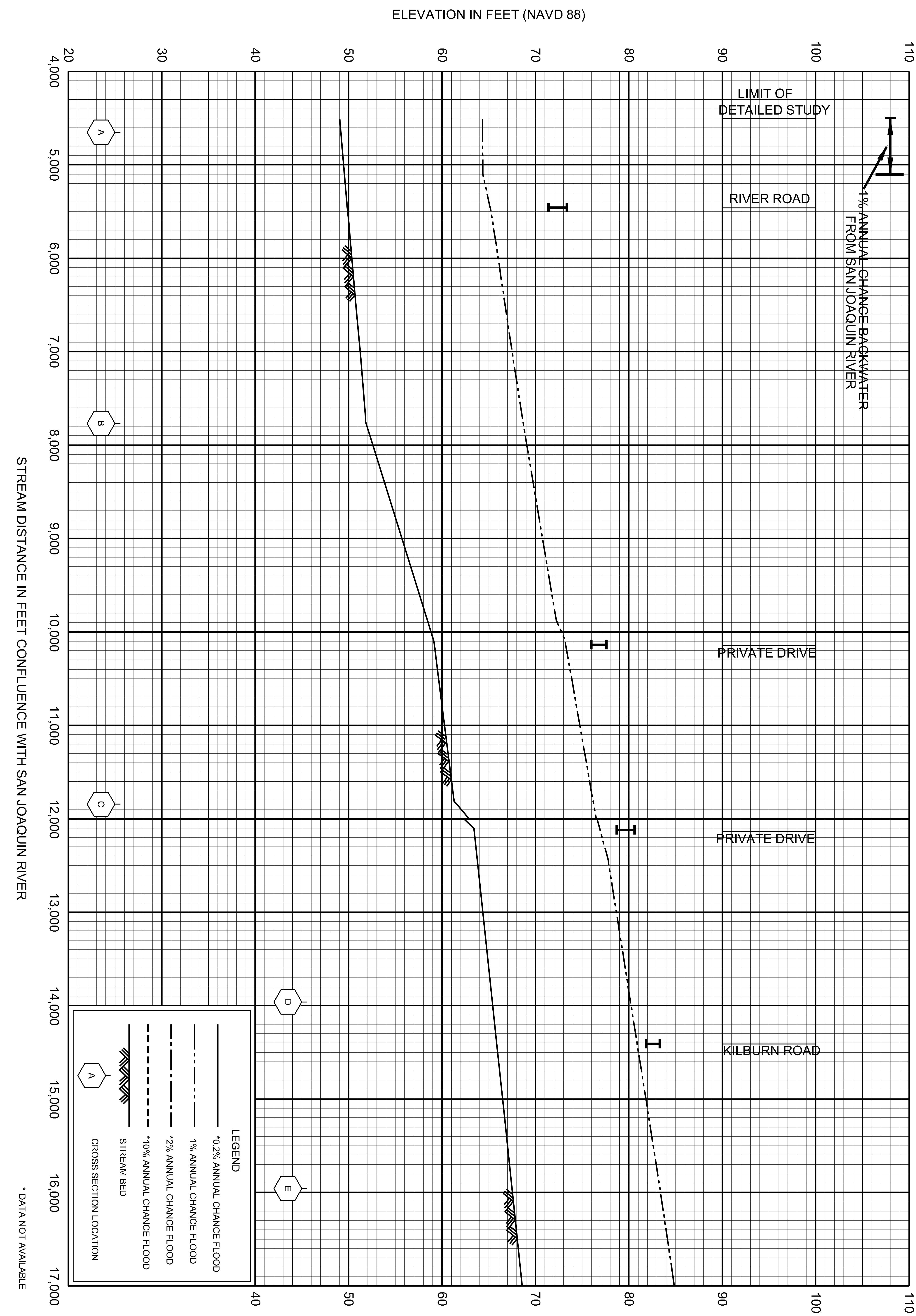
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

DRY CREEK



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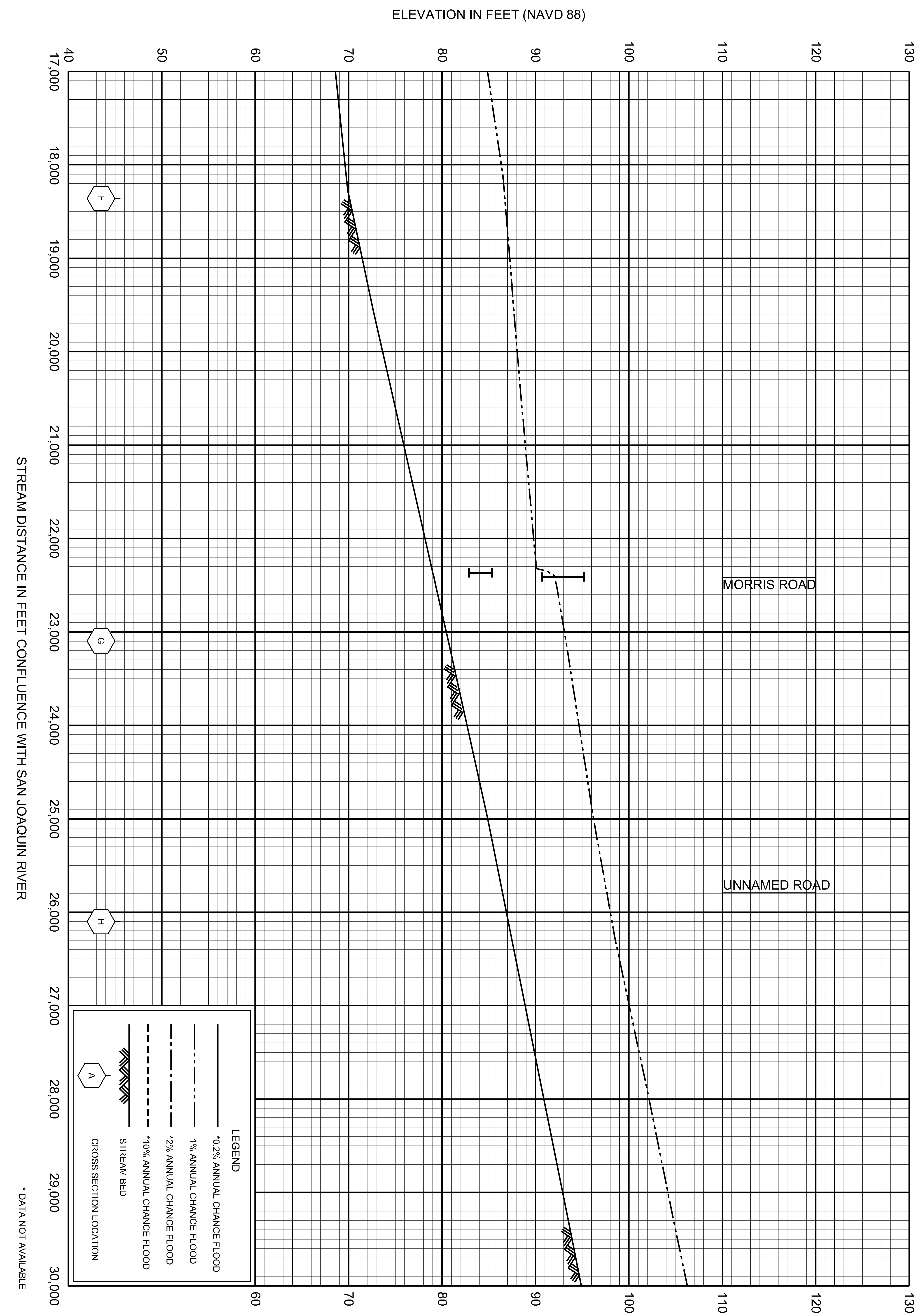
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

ORESTIMBA CREEK



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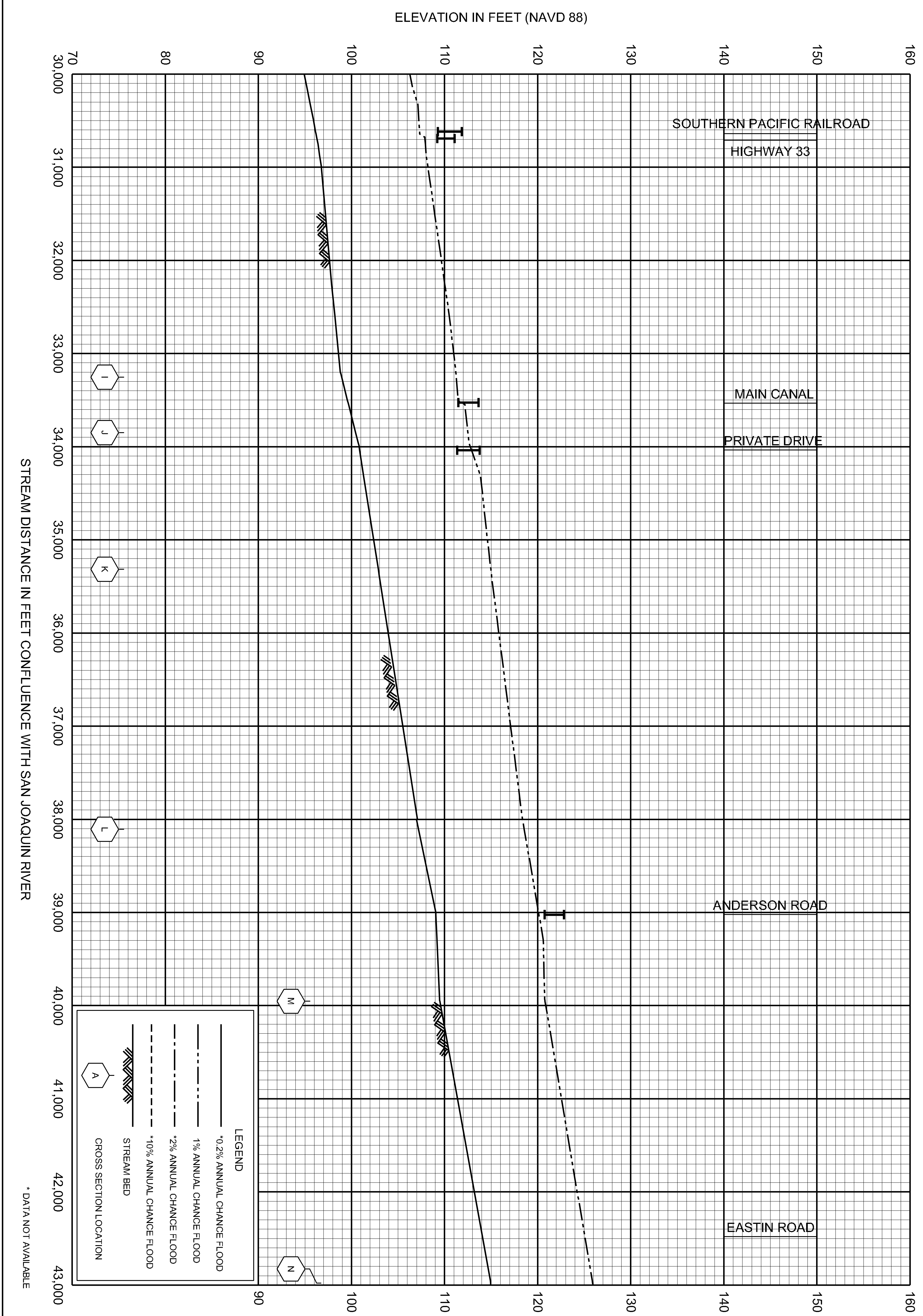
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA
AND INCORPORATED AREAS

FLOOD PROFILES

ORESTIMBA CREEK



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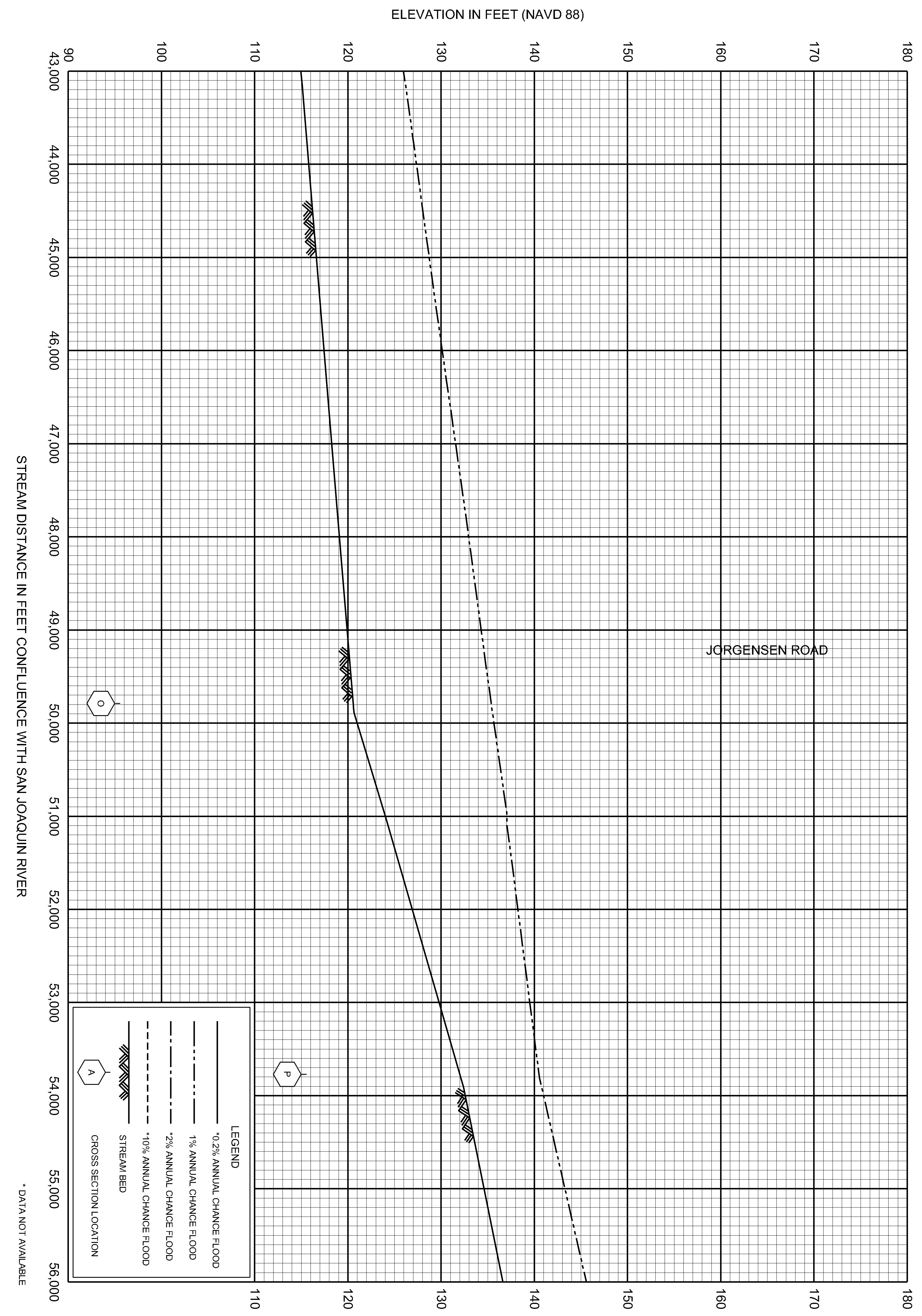
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

ORESTIMBA CREEK



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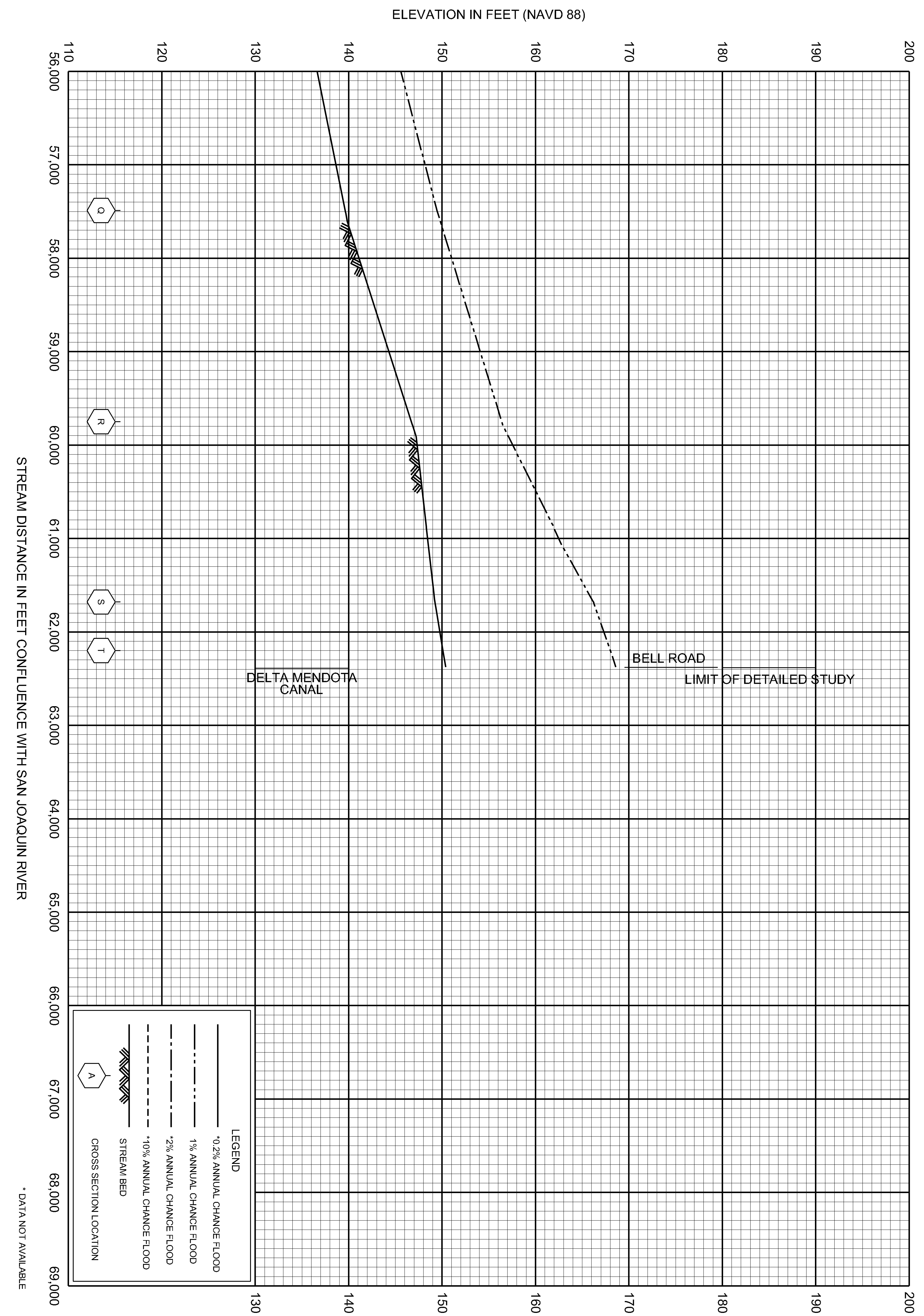
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

ORESTIMBA CREEK



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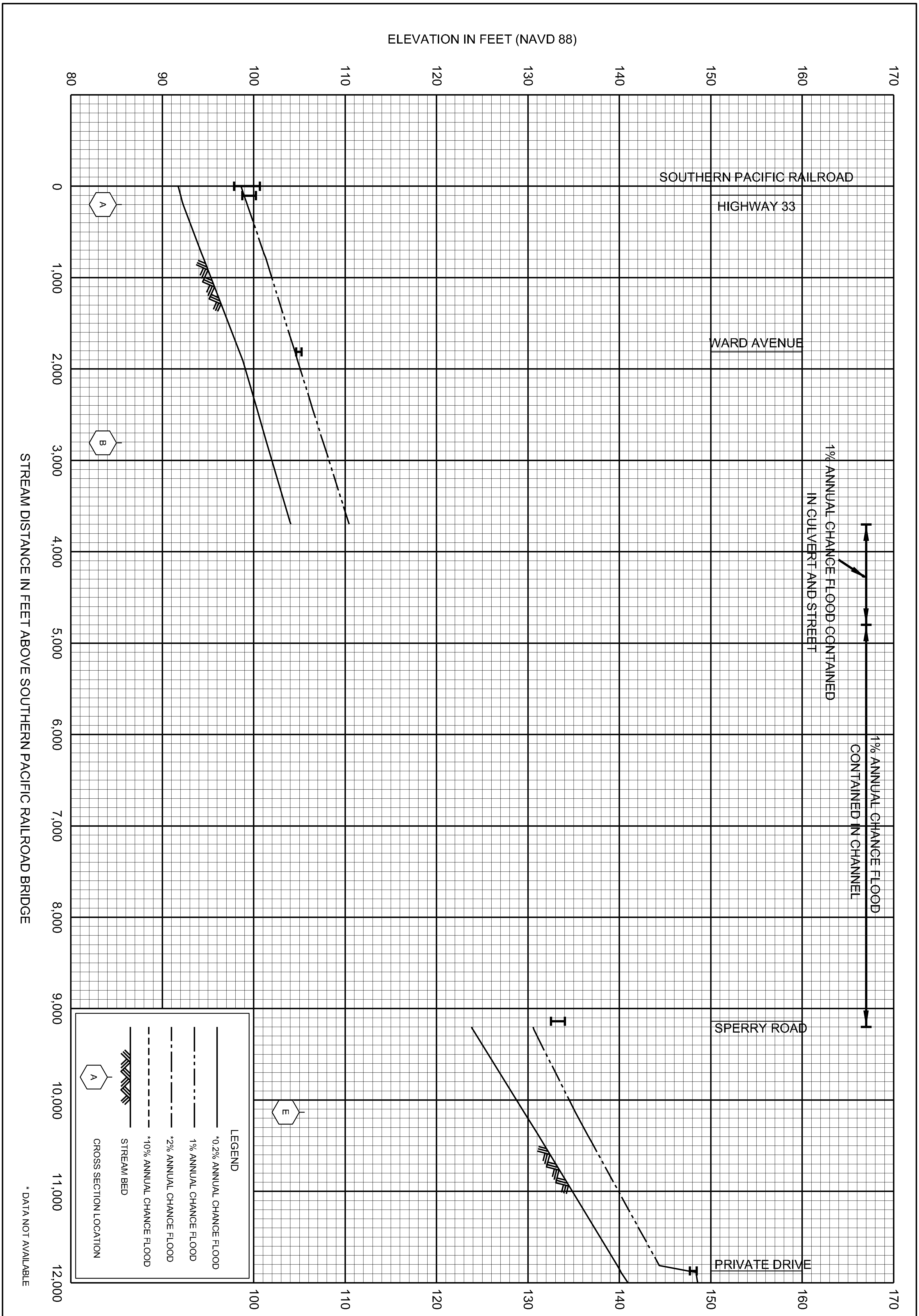
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

ORESTIMBA CREEK



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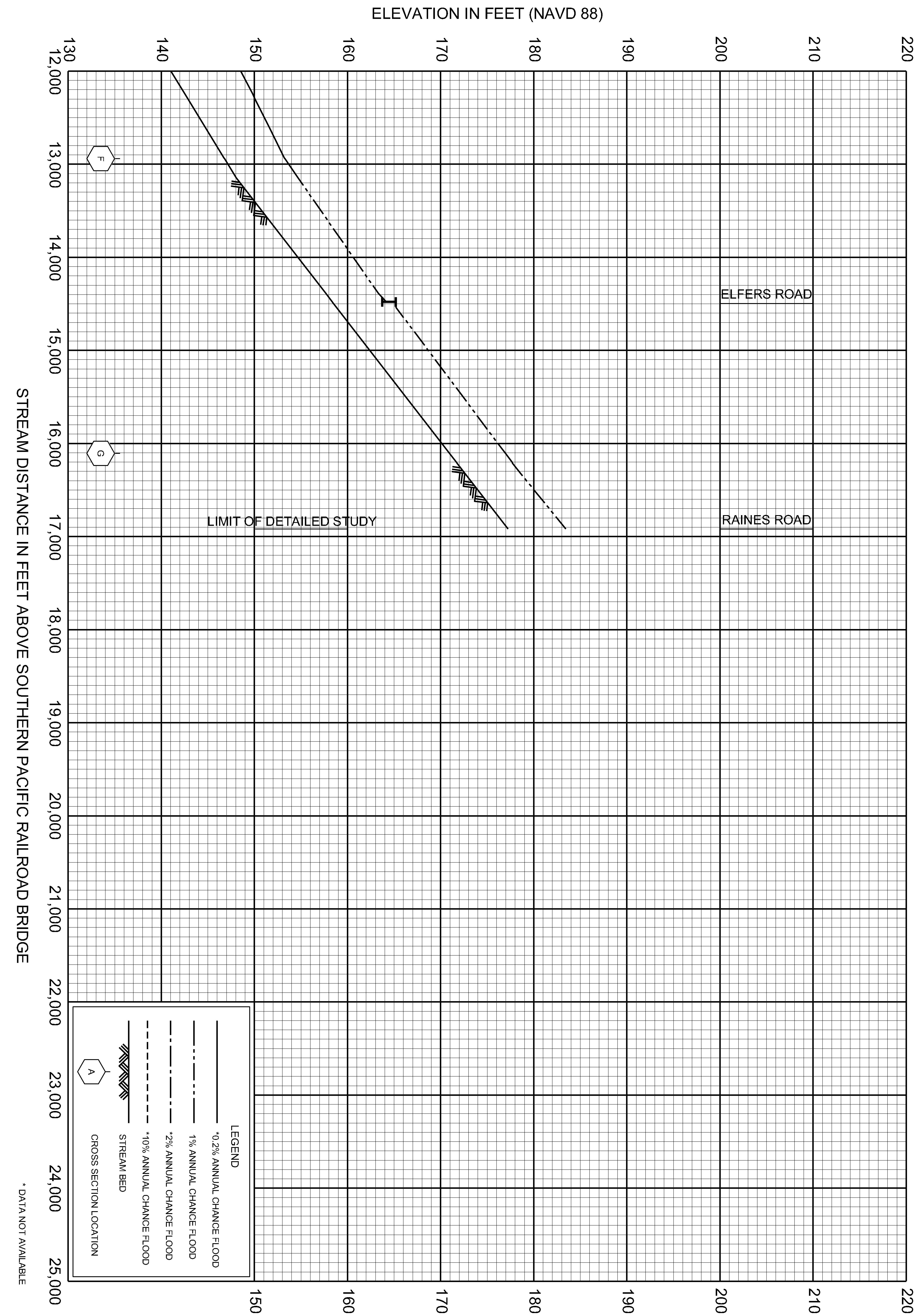
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

SALADO CREEK



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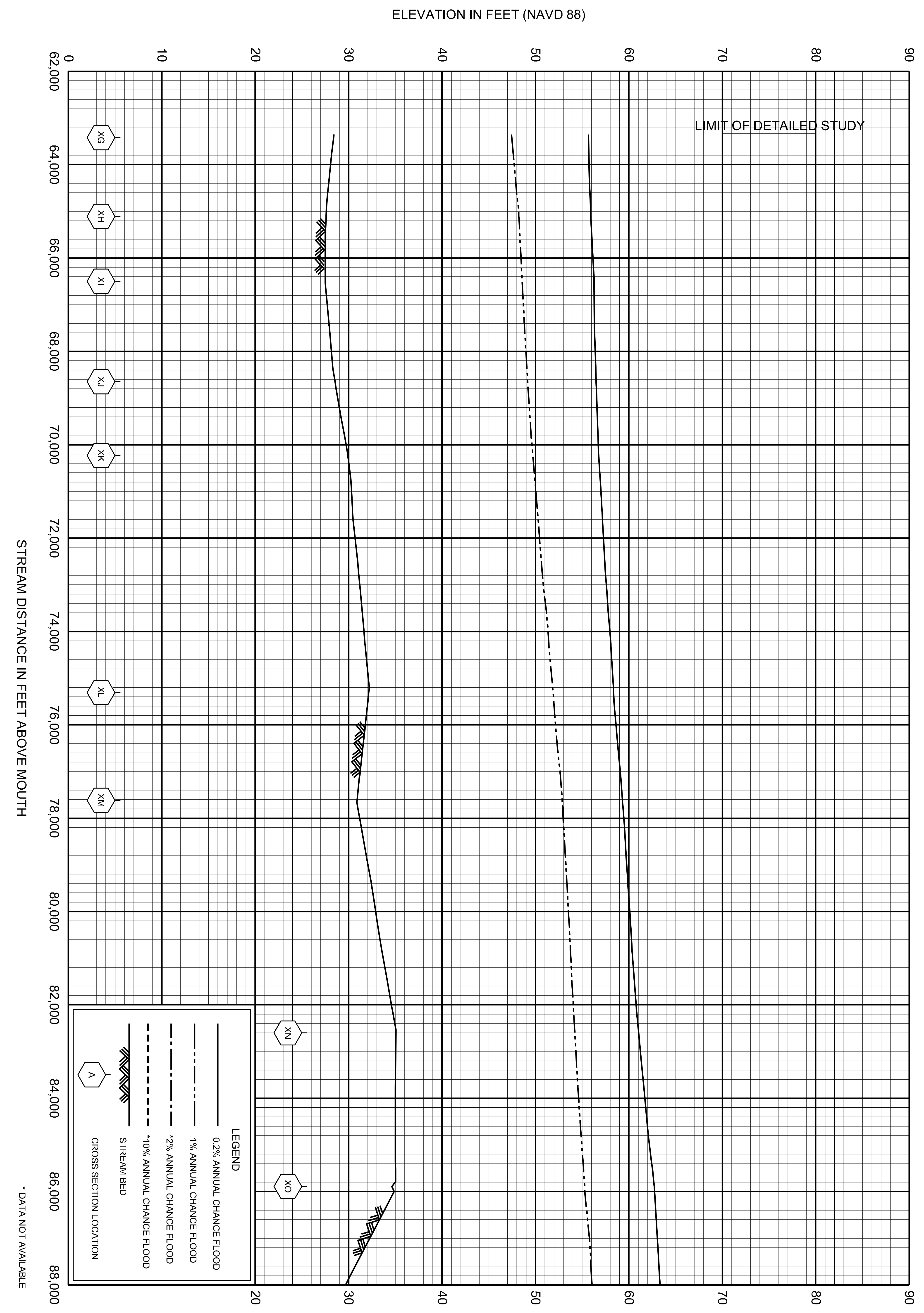
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

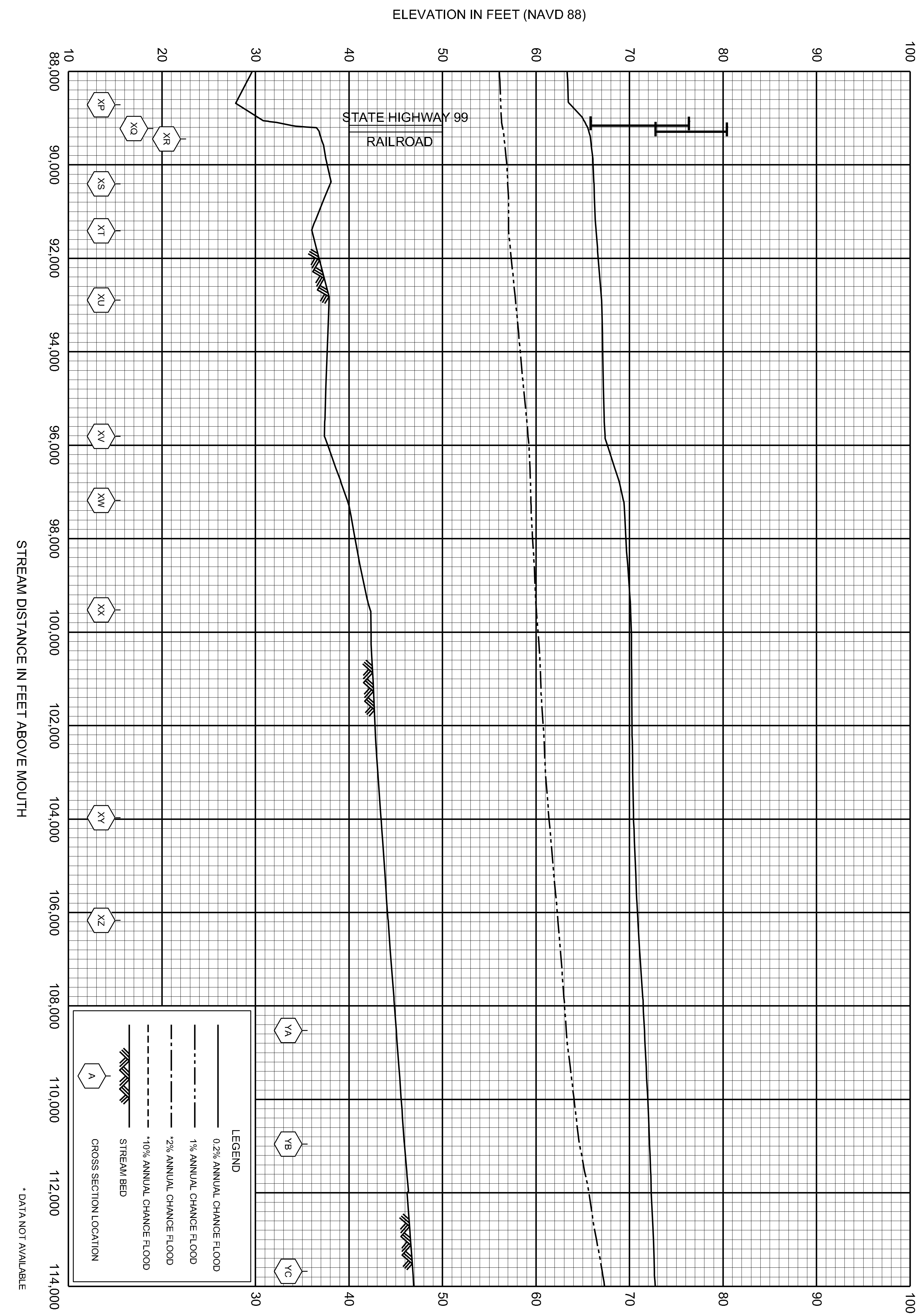
AND INCORPORATED AREAS

FLOOD PROFILES

SALADO CREEK



14P	FEDERAL EMERGENCY MANAGEMENT AGENCY STANISLAUS COUNTY, CA AND INCORPORATED AREAS	FLOOD PROFILES STANISLAUS RIVER



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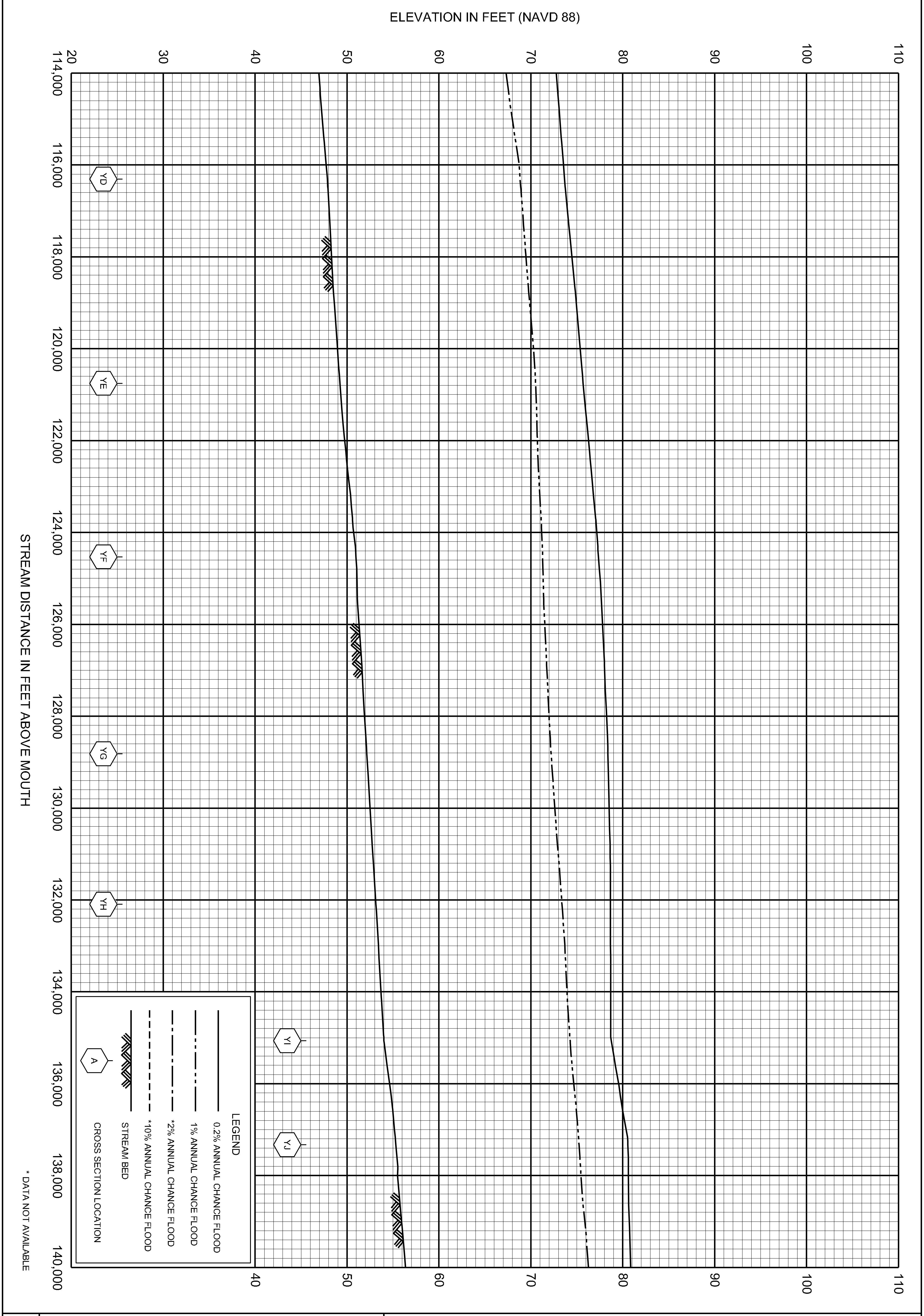

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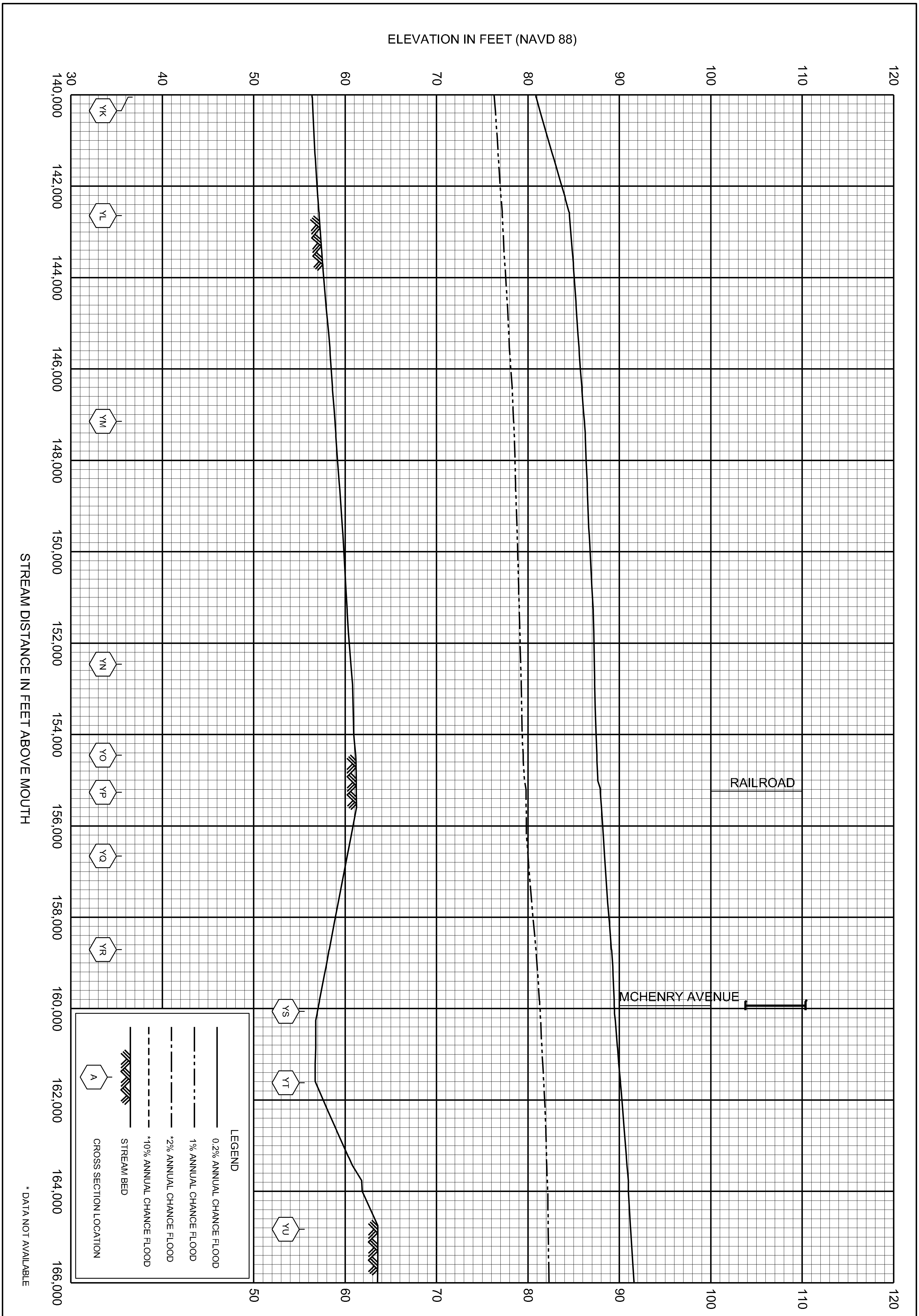
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

STANISLAUS RIVER



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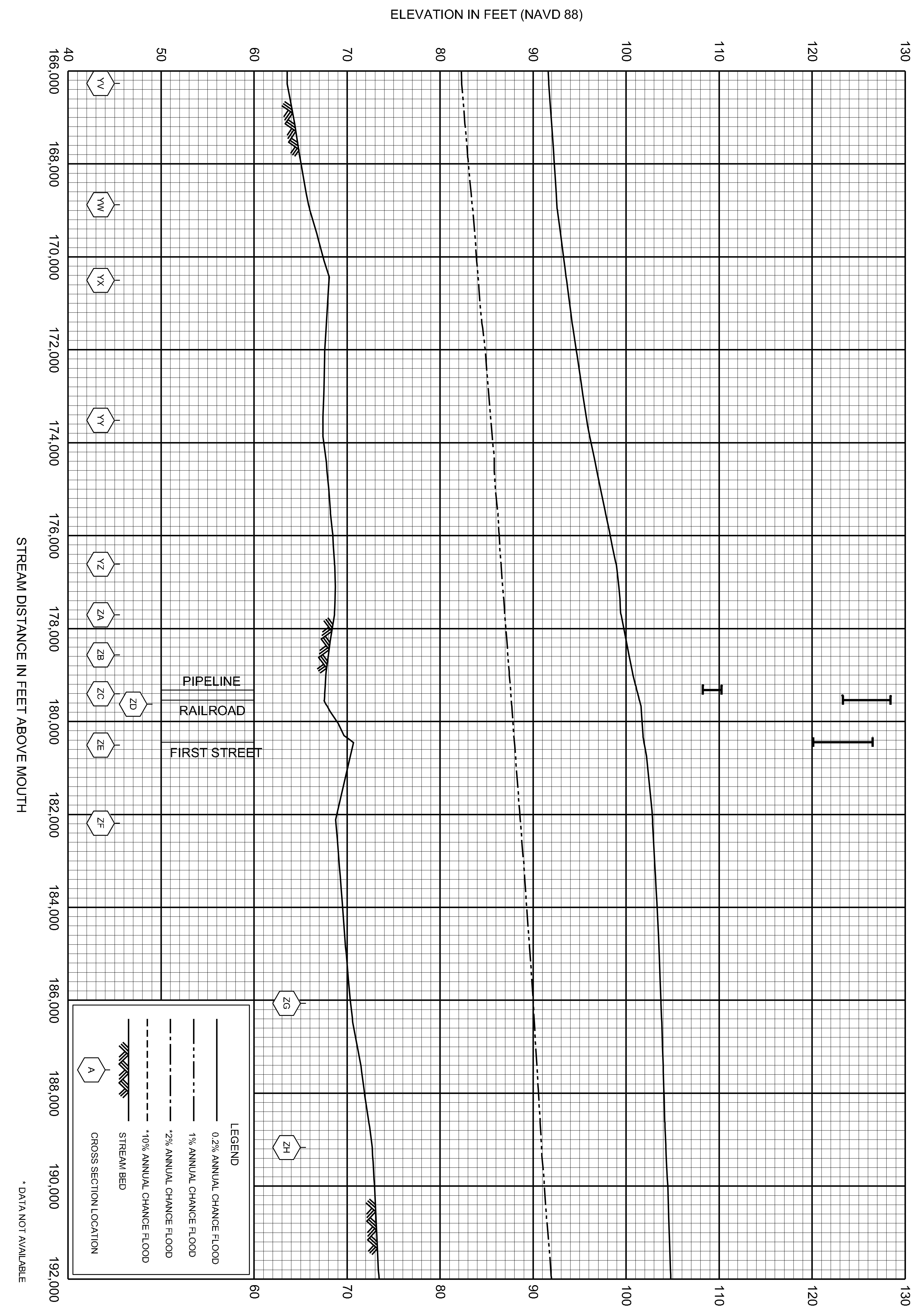
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

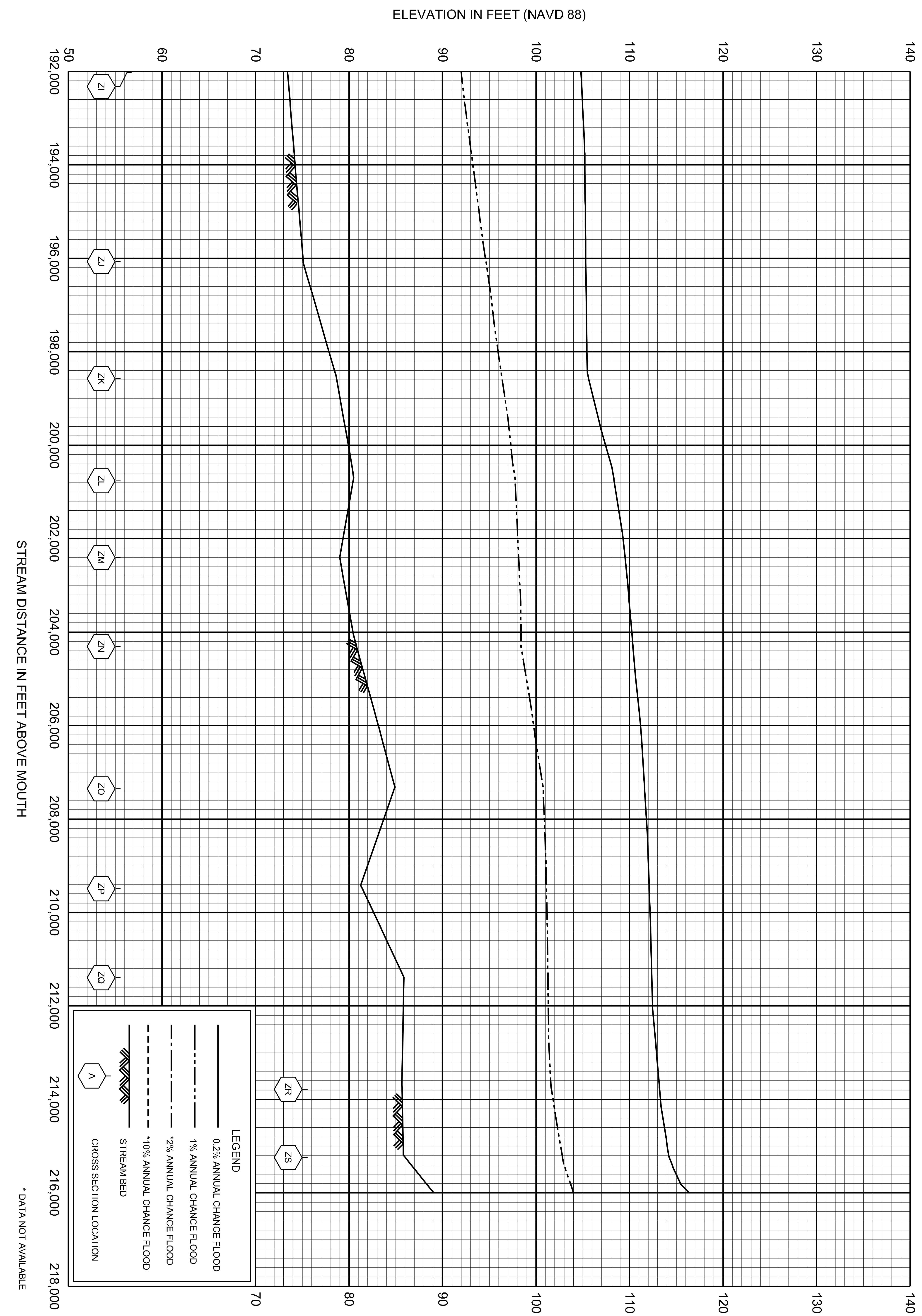
AND INCORPORATED AREAS

FLOOD PROFILES

STANISLAUS RIVER



18P	FEDERAL EMERGENCY MANAGEMENT AGENCY STANISLAUS COUNTY, CA AND INCORPORATED AREAS	FLOOD PROFILES STANISLAUS RIVER



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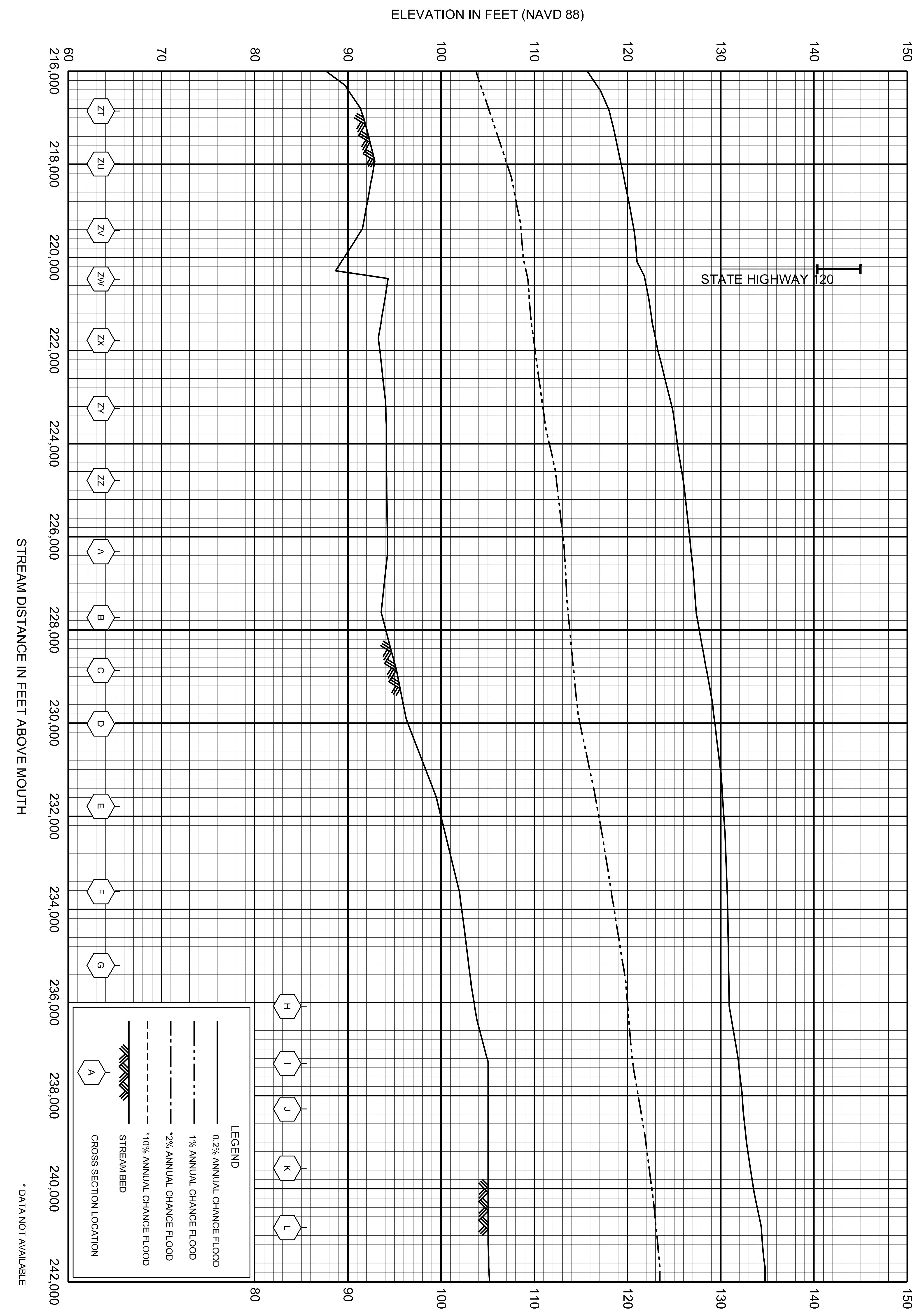
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

STANISLAUS RIVER



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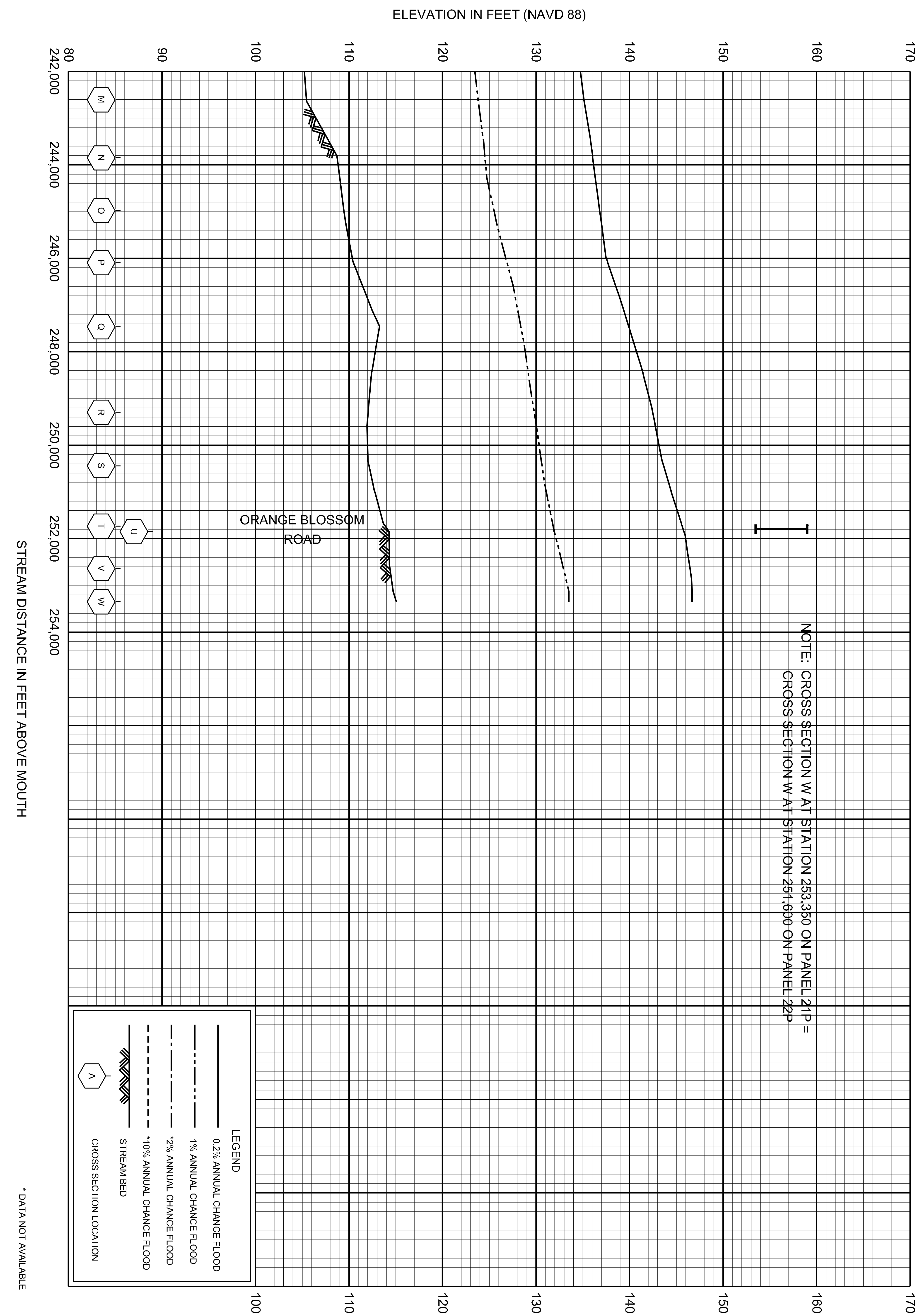
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

STANISLAUS RIVER



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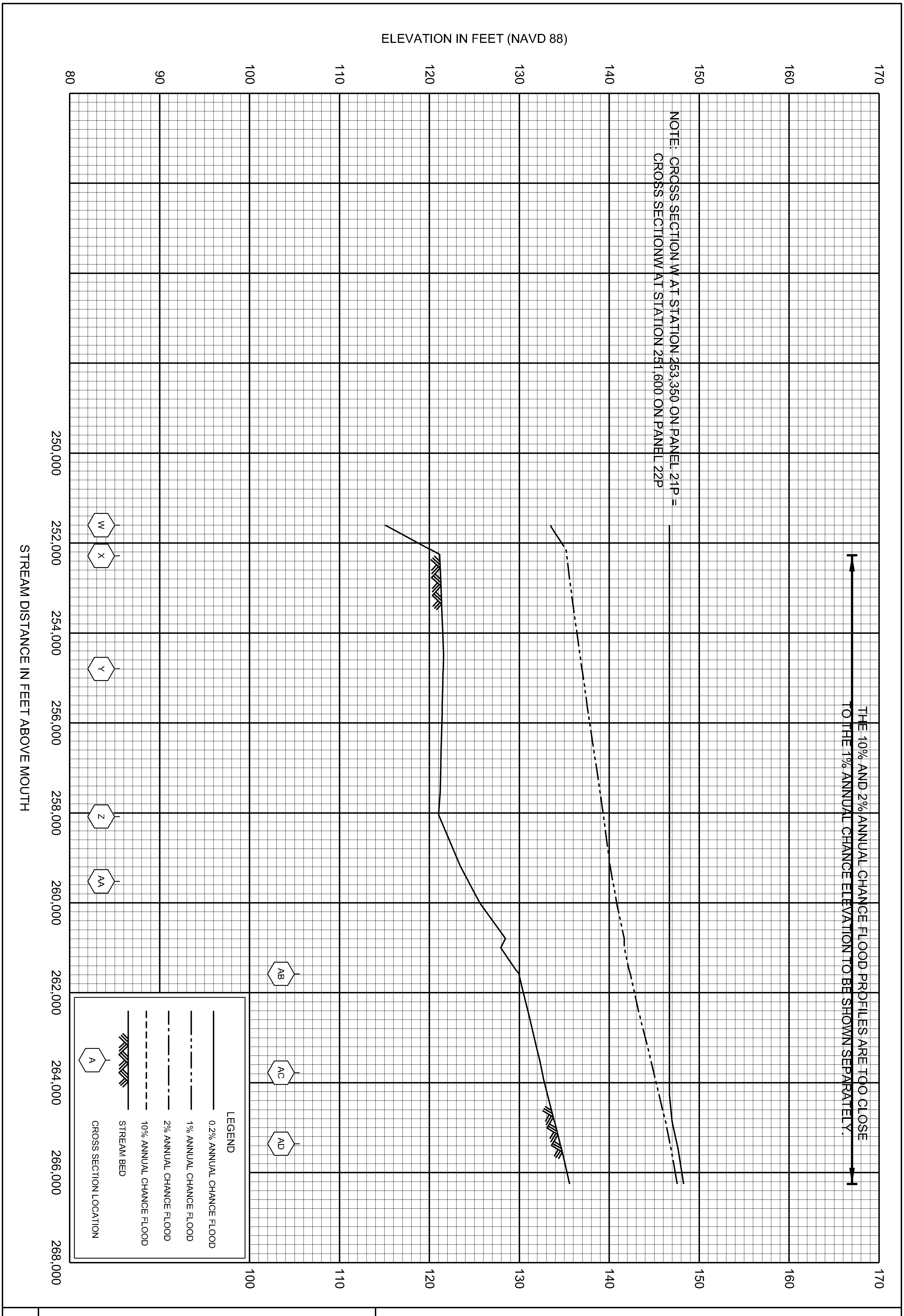
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

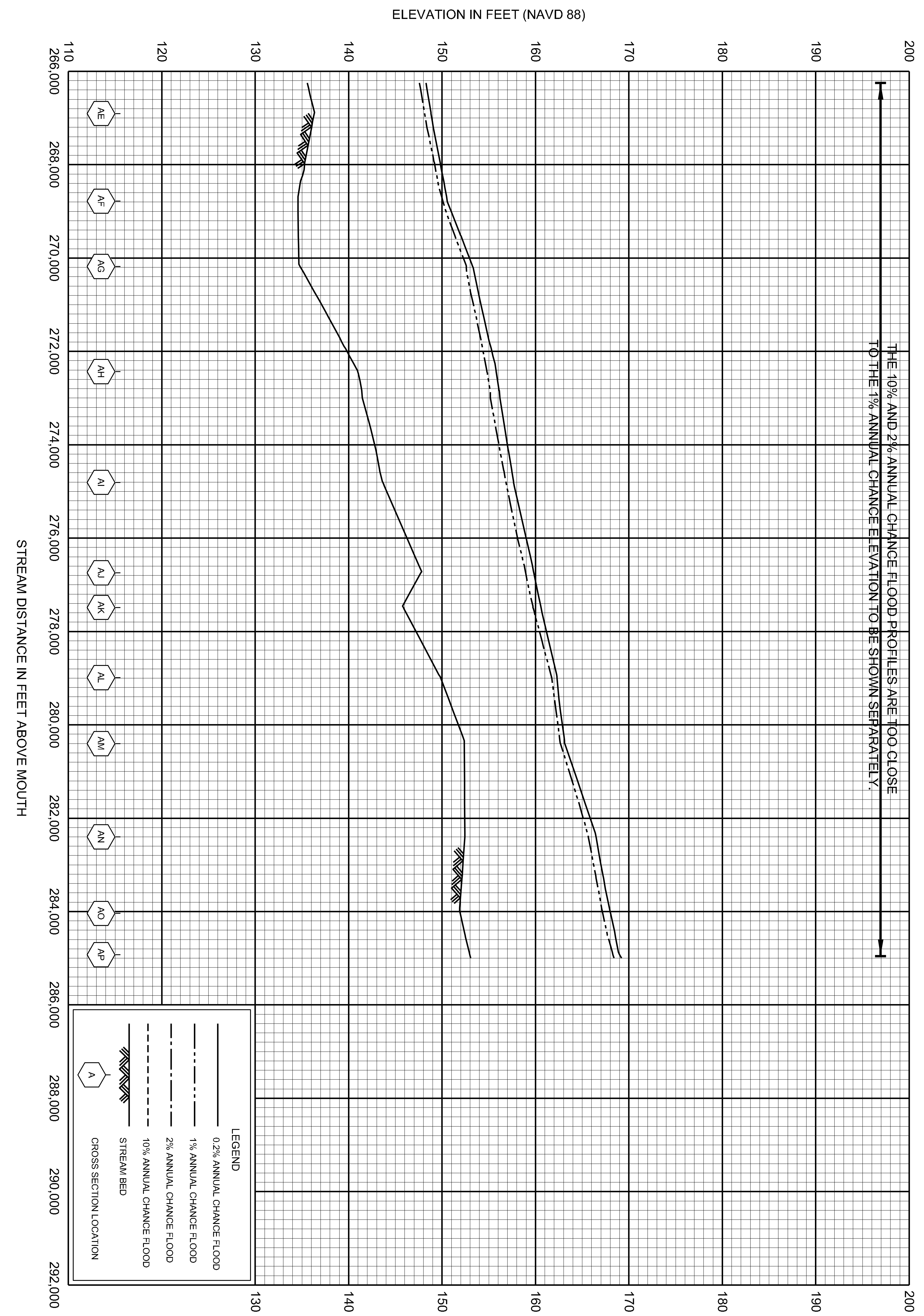
STANISLAUS RIVER



22P	FEDERAL EMERGENCY MANAGEMENT AGENCY STANISLAUS COUNTY, CA AND INCORPORATED AREAS

FLOOD PROFILES

STANISLAUS RIVER



23P

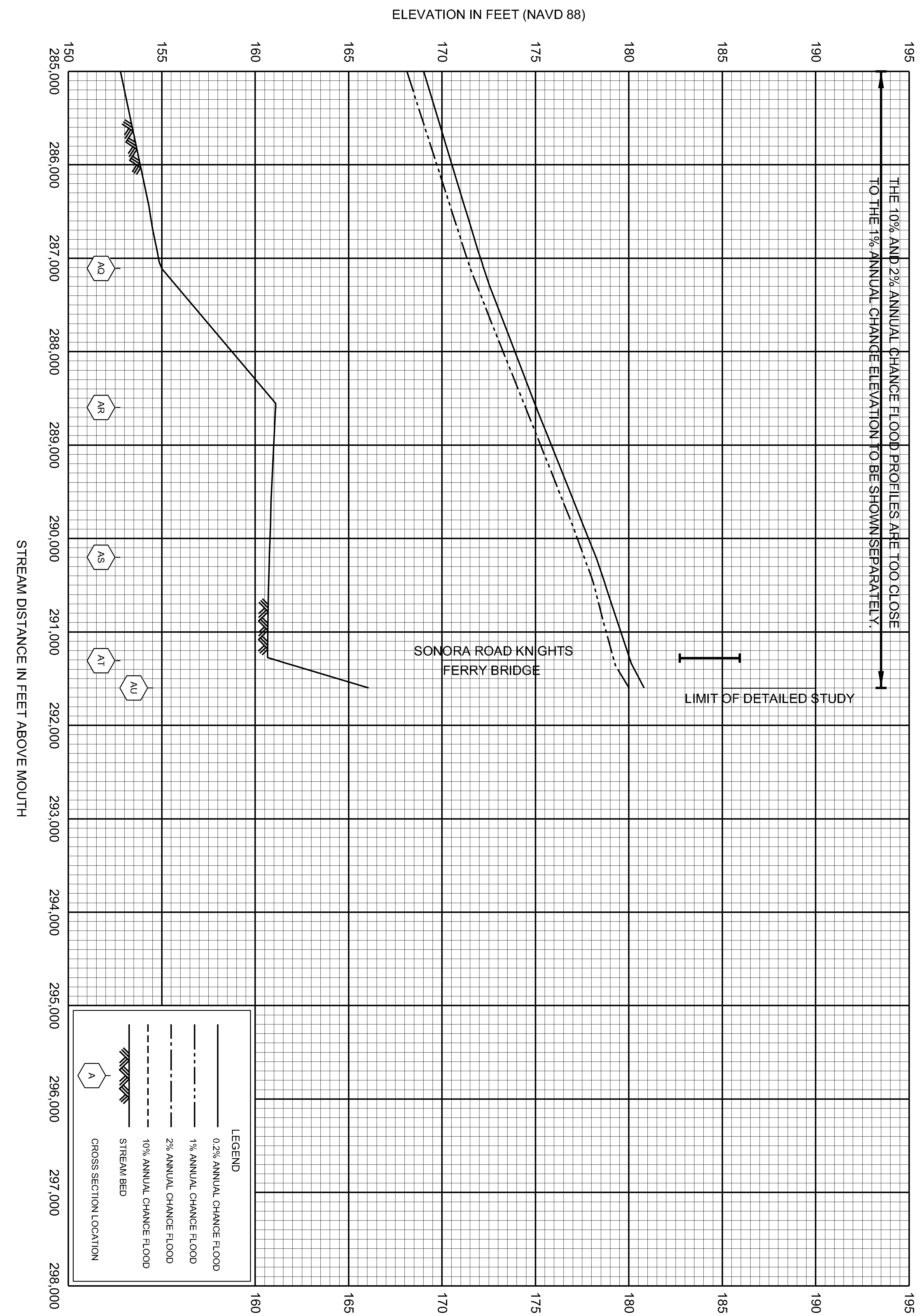
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

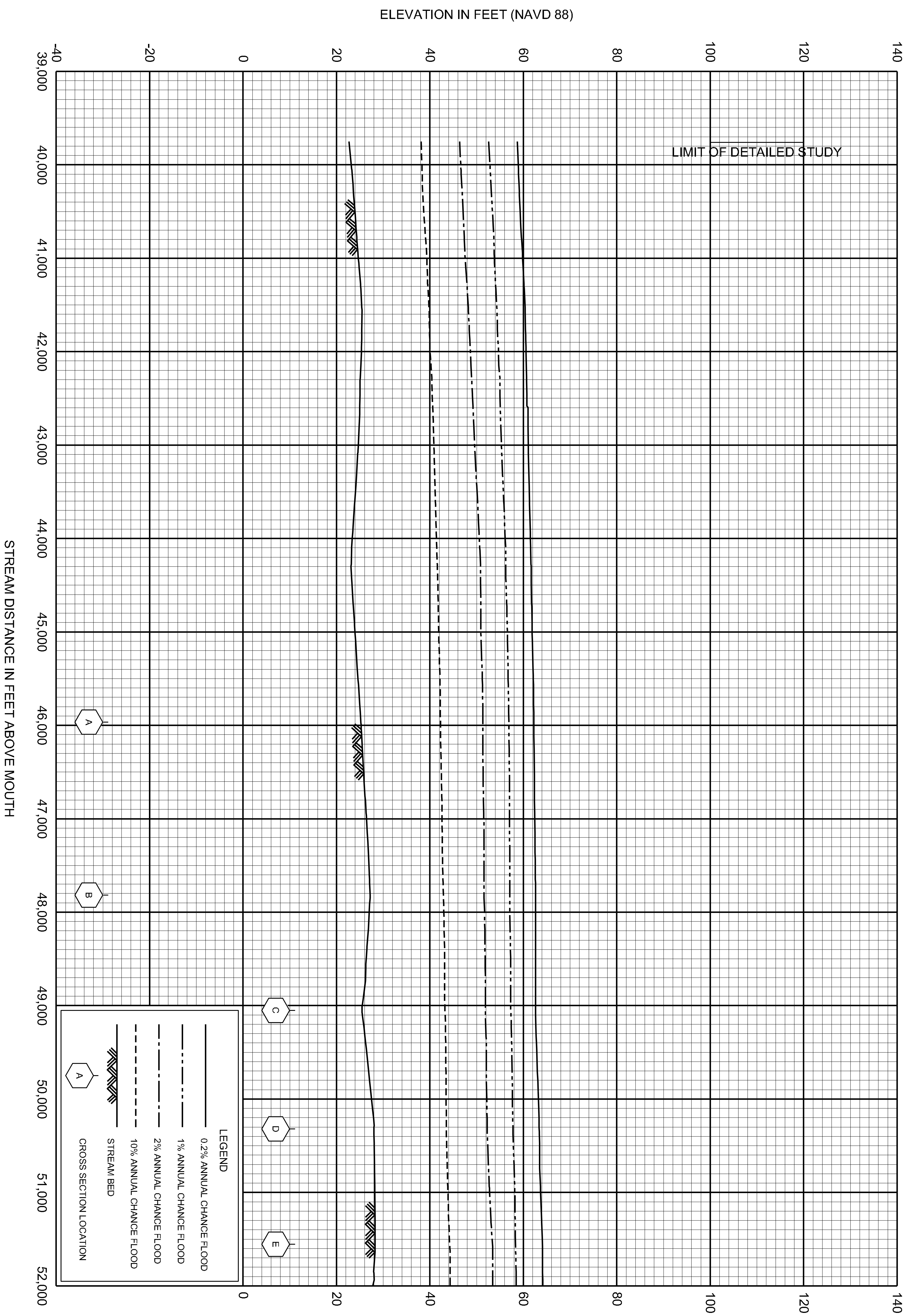
AND INCORPORATED AREAS

FLOOD PROFILES

STANISLAUS RIVER



24P	FEDERAL EMERGENCY MANAGEMENT AGENCY STANISLAUS COUNTY, CA AND INCORPORATED AREAS	FLOOD PROFILES STANISLAUS RIVER



25P

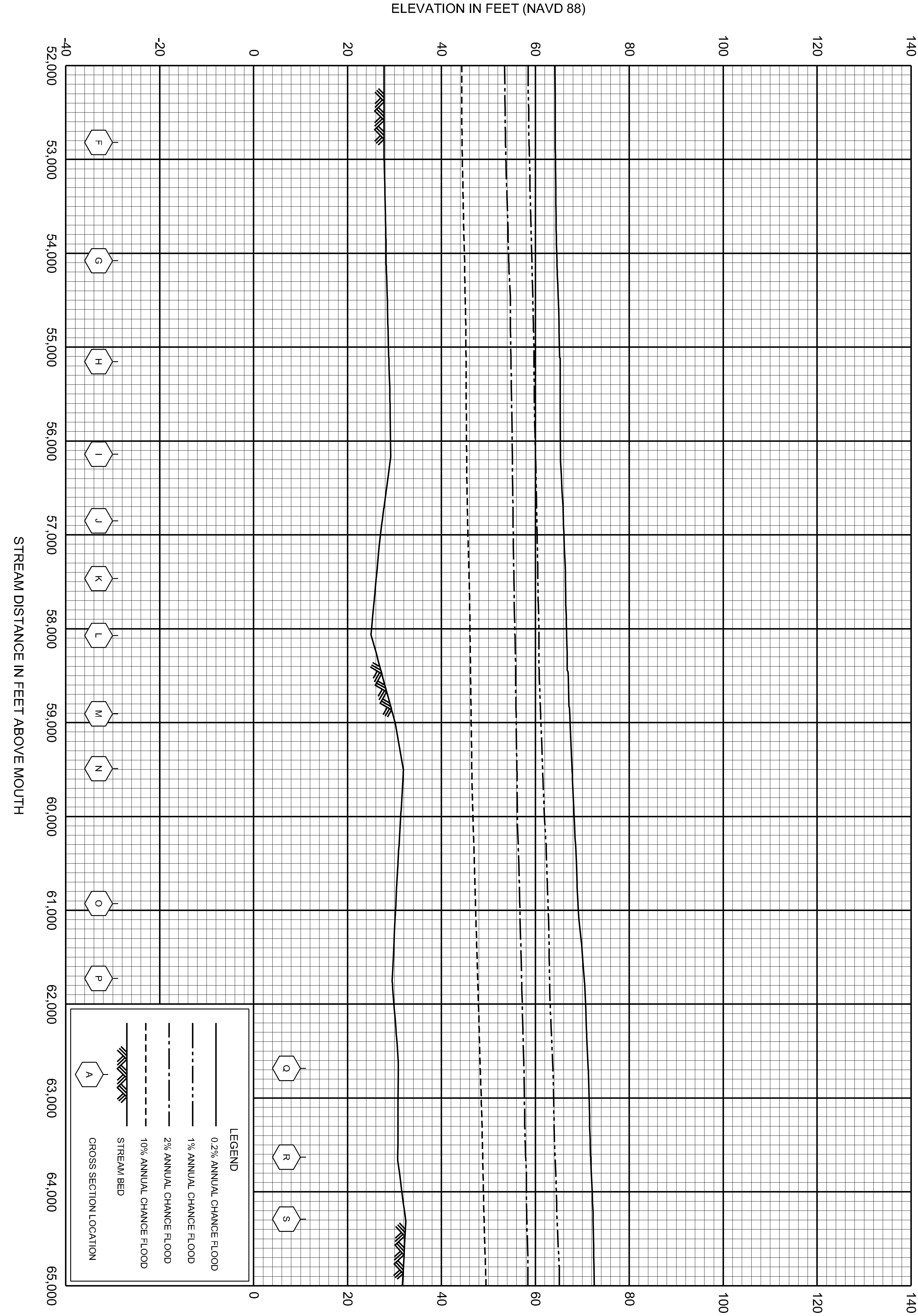
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

TUOLUMNE RIVER AT MODESTO



26P

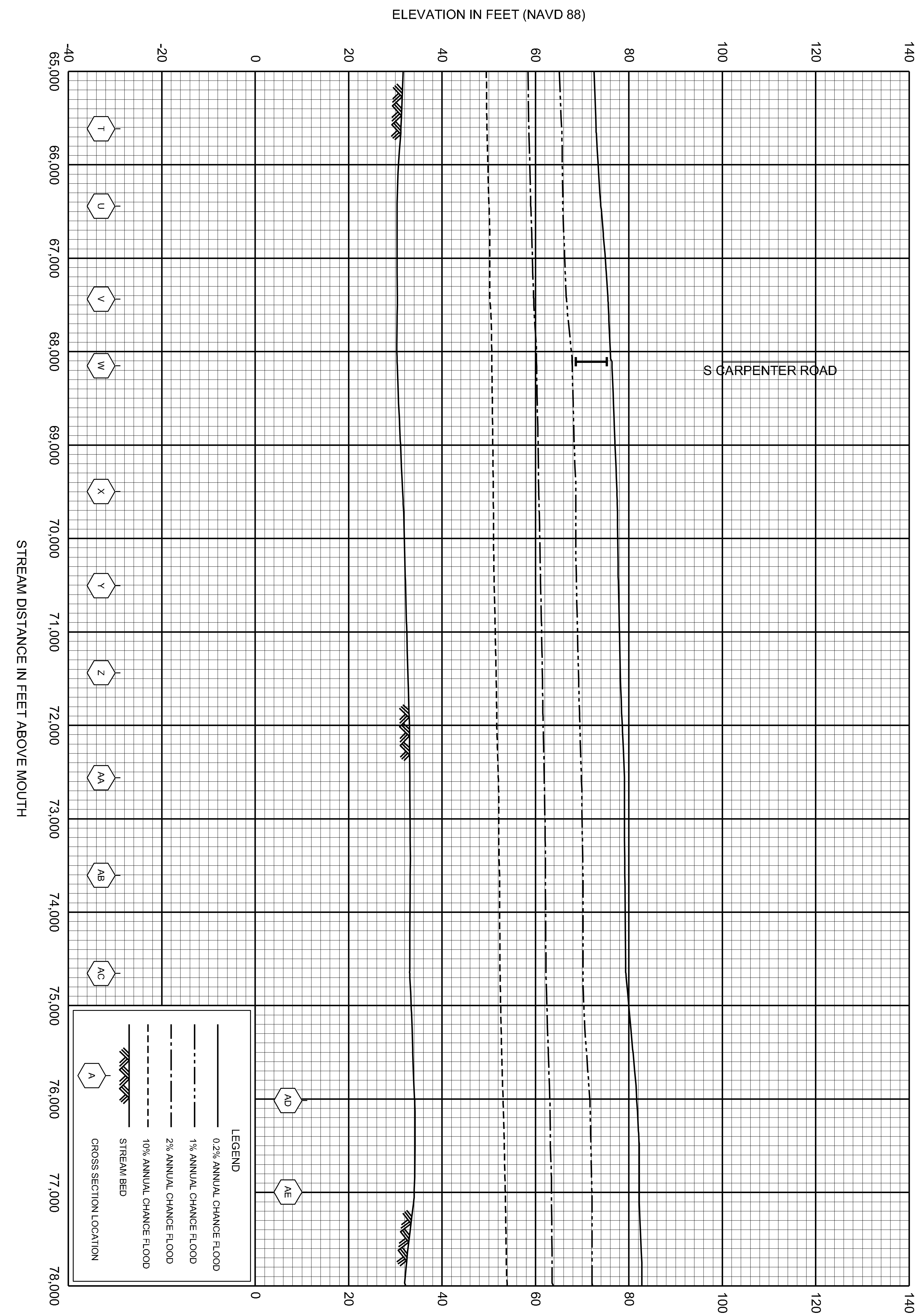
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

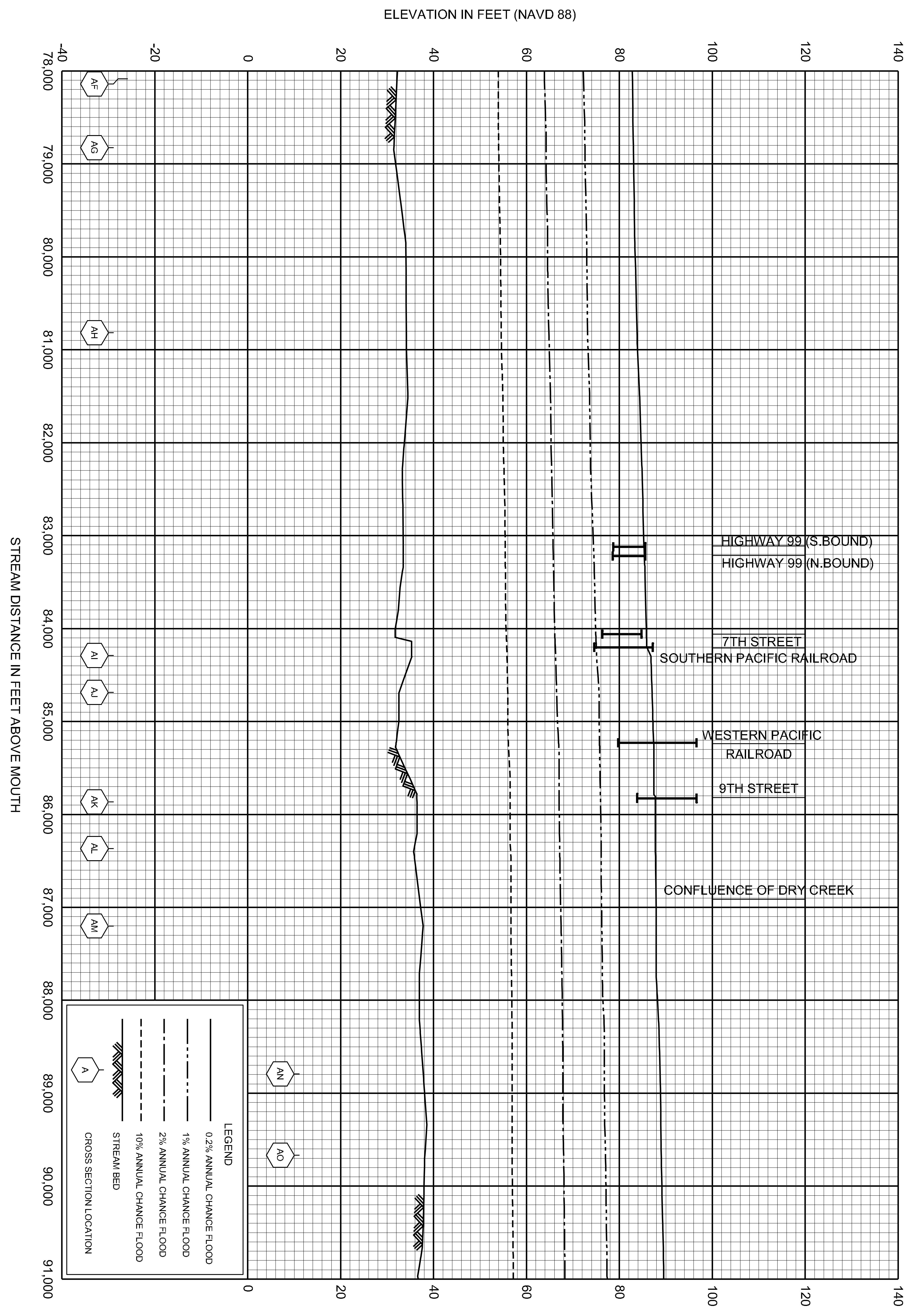
AND INCORPORATED AREAS

FLOOD PROFILES

TUOLUMNE RIVER AT MODESTO



27P	FEDERAL EMERGENCY MANAGEMENT AGENCY STANISLAUS COUNTY, CA AND INCORPORATED AREAS	FLOOD PROFILES TUOLUMNE RIVER AT MODESTO



28P

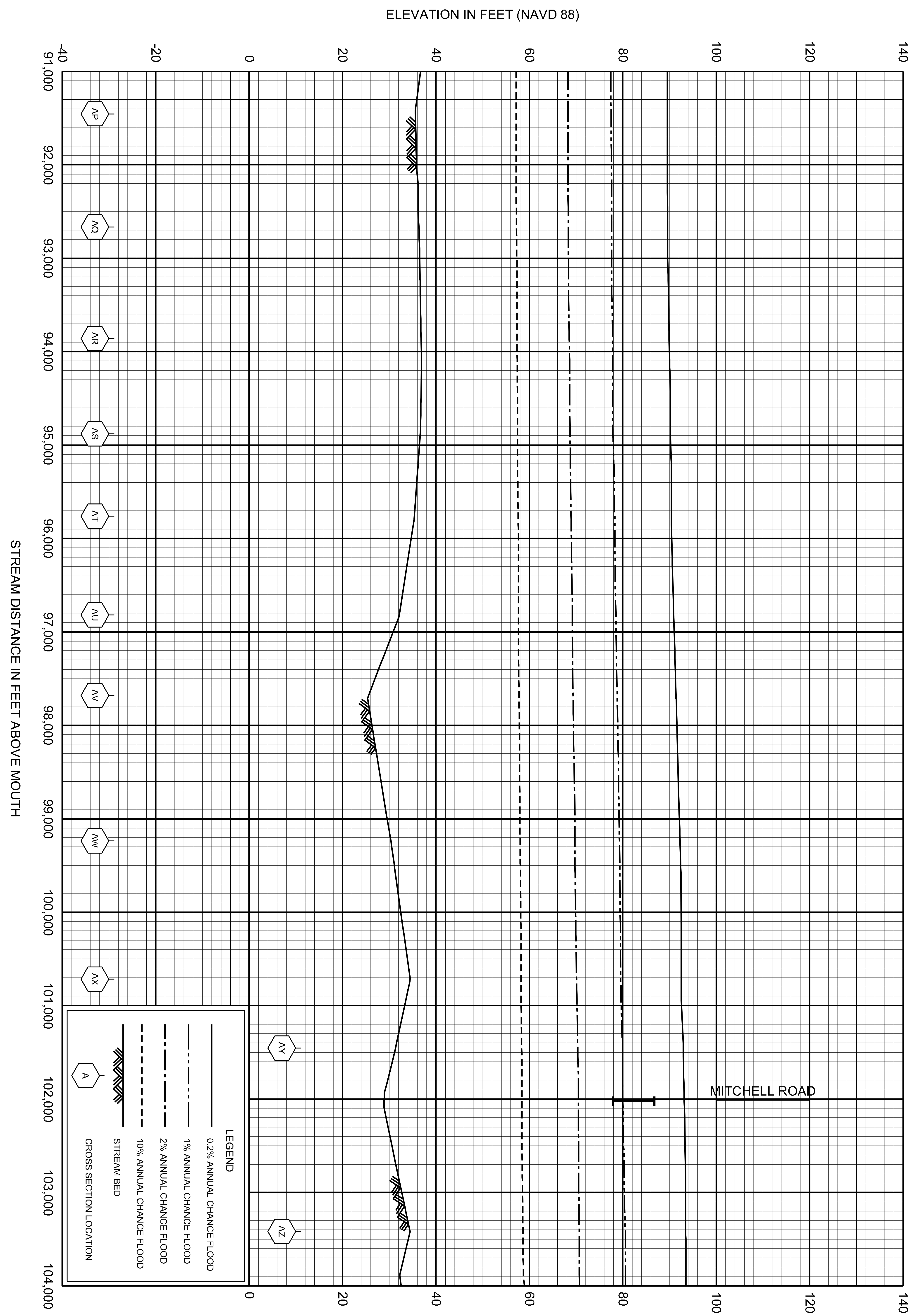
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

TUOLUMNE RIVER AT MODESTO



29P

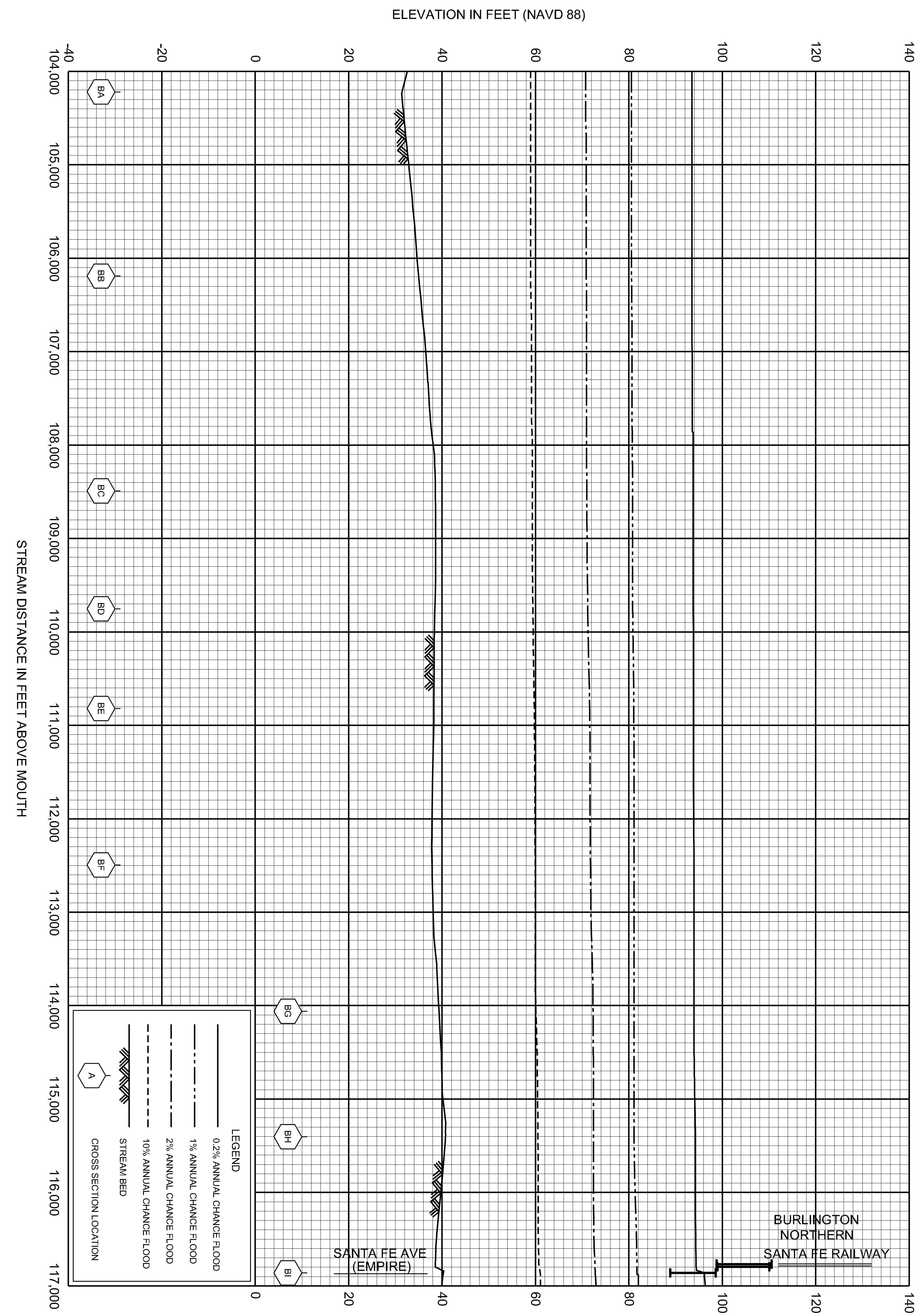
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

TUOLUMNE RIVER AT MODESTO



30P

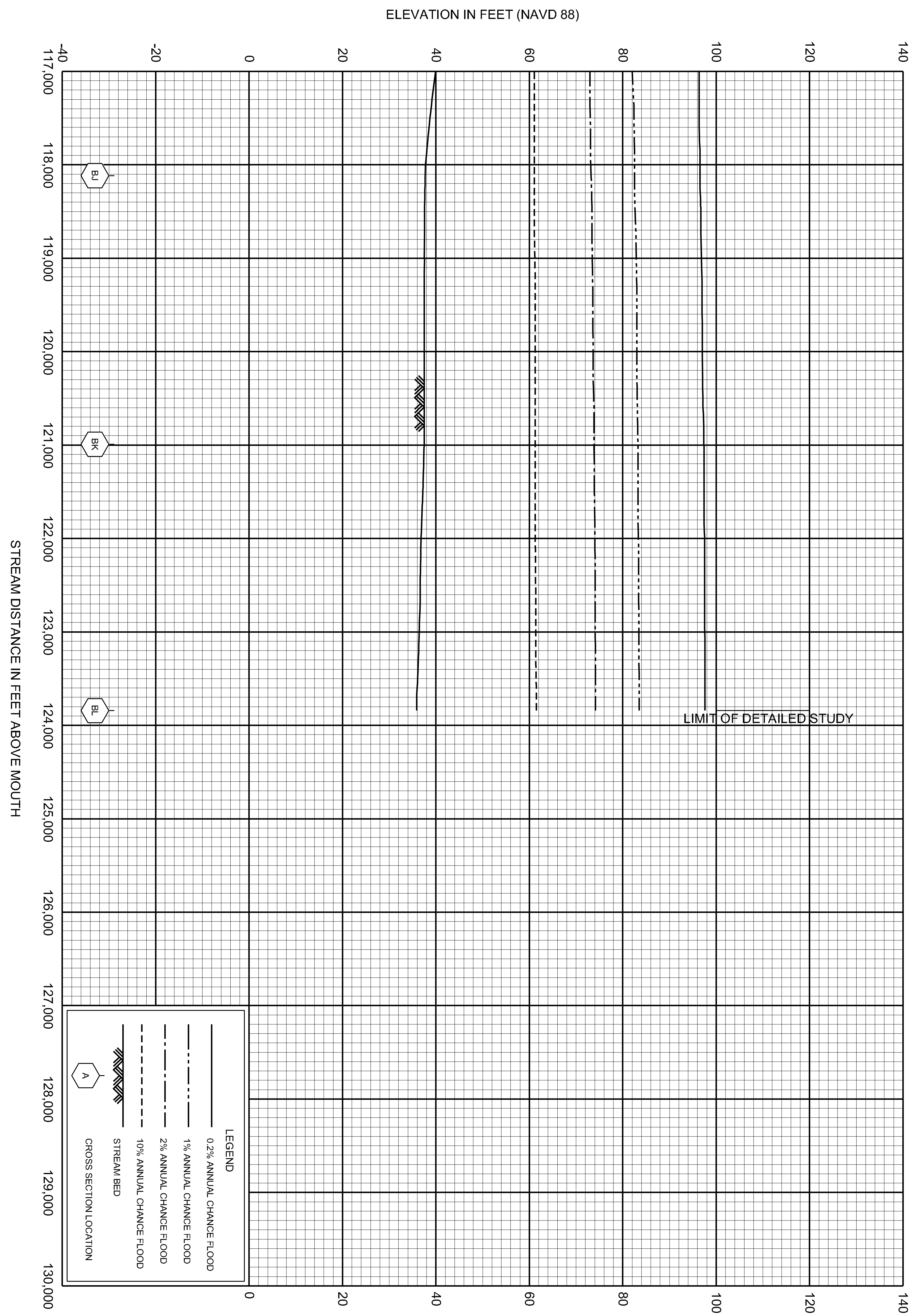
FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

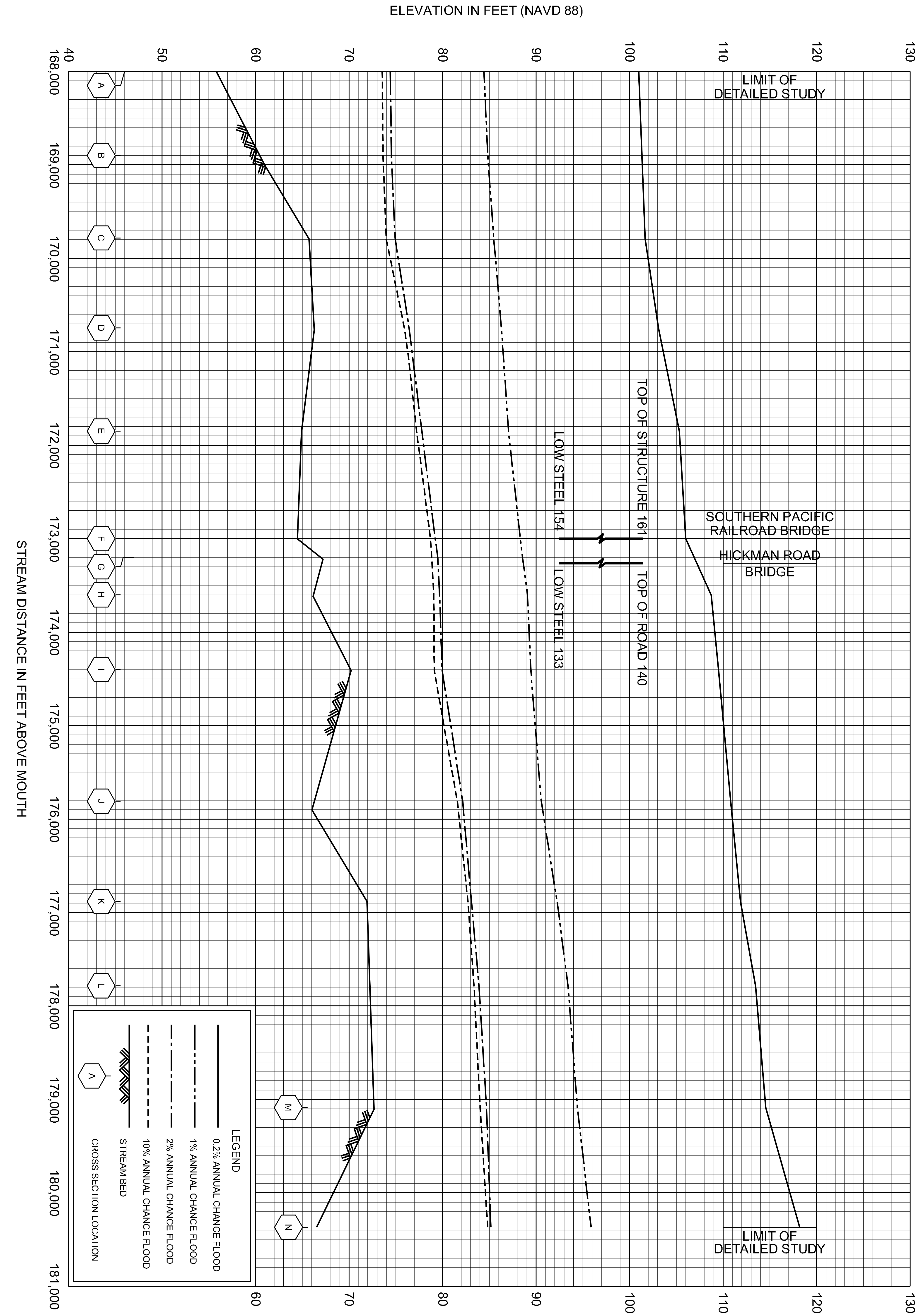
AND INCORPORATED AREAS

FLOOD PROFILES

TUOLUMNE RIVER AT MODESTO



31P	FEDERAL EMERGENCY MANAGEMENT AGENCY STANISLAUS COUNTY, CA AND INCORPORATED AREAS	FLOOD PROFILES TUOLUMNE RIVER AT MODESTO



FEDERAL EMERGENCY MANAGEMENT AGENCY

STANISLAUS COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

TUOLUMNE RIVER AT WATERFORD