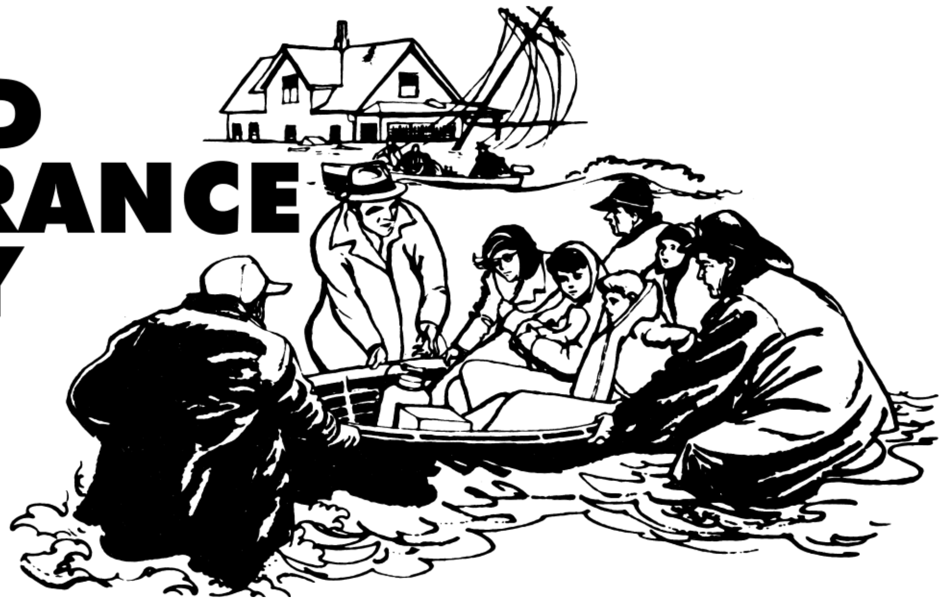
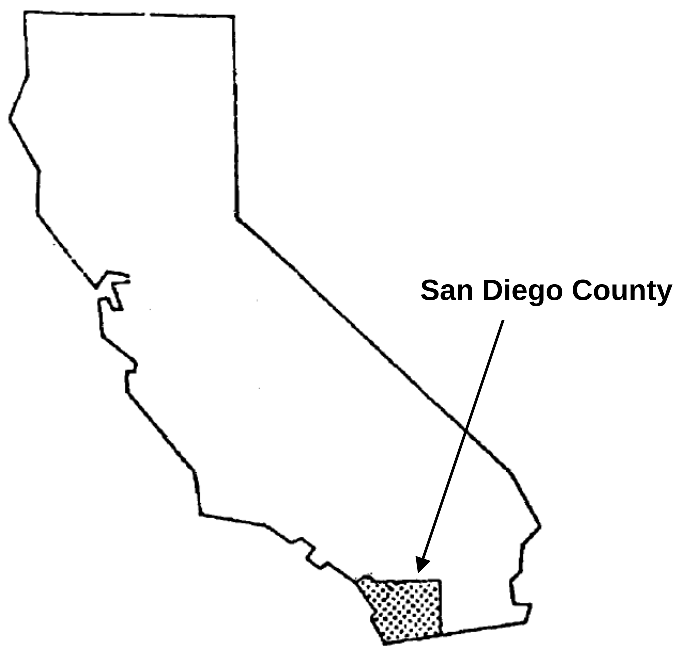
FLOOD INSURANCE STUDY



SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

VOLUME 1 OF 11

Community Name	Community Number
SAN DIEGO COUNTY, UNINCORPORATED AREAS	060284
CARLSBAD, CITY OF	060285
CHULA VISTA, CITY OF	065021
CORONADO, CITY OF	060287
DEL MAR, CITY OF	060288
EL CAJON, CITY OF	060289
ENCINITAS, CITY OF	060726
ESCONDIDO, CITY OF	060290
IMPERIAL BEACH, CITY OF	060291
LA MESA, CITY OF	060292
LEMON GROVE, CITY OF	060723
NATIONAL CITY, CITY OF	060293
OCEANSIDE, CITY OF	060294
POWAY, CITY OF	060702
SAN DIEGO, CITY OF	060295
SAN MARCOS, CITY OF	060296
SANTEE, CITY OF	060703
SOLANA BEACH, CITY OF	060725
VISTA, CITY OF	060297



REVISED
May 16, 2012

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06073CV001C

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.

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: June 19, 1997

Revised Countywide FIS Dates:	June 16, 1999
	January 19, 2001
	July 16, 2002
	September 29, 2006
	May 16, 2012

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EXHIBIT 1 – FLOOD PROFILES

FLOOD INSURANCE STUDY
SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of San Diego County, California, including the Cities of Carlsbad, Chula Vista, Coronado, Del Mar, El Cajon, Encinitas, Escondido, Imperial Beach, La Mesa, Lemon Grove, National City, Oceanside, Poway, San Diego, San Marcos, Santee, Solana Beach and Vista, and the unincorporated areas of San Diego County (referred to collectively herein as San Diego County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by San Diego 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, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which this federally supported study is based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3(c). In such cases, however, it shall be understood that the State (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

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

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

San Diego County

The hydrologic and hydraulic analyses in the initial study for Broadway Creek and Sweetwater River (near National City) were performed by the U.S. Army Corps of Engineers (USACE), Los Angeles District, for FEMA under Interagency Agreement No. H-19-74, Project Order No. 13 and Interagency Agreement No. H-16-75, Project Order No. 22. This work was completed in June and September 1976, respectively.

The hydrologic and hydraulic analyses for South Las Chollas Creek and Las Puleta Creek in the initial study were performed by the City of San Diego for the Federal Emergency Management Agency (FEMA), and were completed in September 1979.

Hydrologic and hydraulic analyses in the initial study for Agua Hedionda Creek, Buena Creek, Escondido Creek, Hatfield Creek, Kit Carson Park Creek downstream of its confluence with Kit Carson Park Creek Tributary, Kit Carson Park Creek Tributary, Los Coches Creek, North Tributary to Santa Maria Creek, the Otay River, Reidy Creek, Santa Maria Creek (Santa Maria Valley Area), South Tributary to Santa Maria Creek, a portion of the Sweetwater River, Telegraph Canyon Creek, South Tributary to Santa Maria Creek, and hydrologic and preliminary hydraulic analyses in the initial study for Carroll Canyon Creek, Casa de Oro Creek, Descanso Creek, Kit Carson Park Creek, Samagutuma Creek, the San Diego River, San Vicente Creek, Spring Valley Creek and Sweetwater River (Descanso area) were performed by the California Department of Water Resources for FEMA under Contract No. H-3947. Final hydraulic analyses for Carroll Canyon Creek, Casa de Oro Creek, Descanso Creek, Harbison Canyon Creek, Kit Carson Park Creek, Samagutuma Creek, the San Diego River, San Vicente Creek, Spring Valley Creek, and the Sweetwater River (Descanso area) were performed by Dames & Moore under Contract No. C-0542. Hydrologic and hydraulic analyses for the Pacific Ocean were performed by Tetra Tech, Inc., under Contract No. H-4543. This work was completed in December 1981.

The updated hydraulic analysis for Harbison Canyon Creek was performed by the San Diego County Department of Public Works. This work was completed in May 1986.

The initial hydrologic analyses for San Luis Rey River, Moosa Canyon Creek and South Fork Moosa Canyon Creek were performed by the California Department of Water Resources under Contract No. H-3947.

Hydraulic analyses for Alpine Creek, Moosa Canyon Creek, South Fork Moosa Canyon Creek, the San Luis Rey River, Santa Maria Creek (San Pasqual Valley area), Santa Ysabel Creek, and the Sweetwater River were performed by Nolte and Associates under Contract No. EMW-83-6-1163. This work was completed in August 1986.

Revisions to the flood delineations along Los Coches Creek resulted from the construction of a concrete-lined channel from its confluence with San Diego River west of Winter Garden Boulevard to Ha-Hana Road. Technical data to support the revision were prepared by the USACE, Los Angeles District. This work was completed in February 1987.

Floodplain and floodway boundary delineation revisions along South Fork Moosa Canyon Creek from a point approximately 2,400 feet downstream of Champagne Boulevard to Champagne Boulevard were based on information prepared by Civil Design Group, Ltd. These revisions were the result of channel improvements through the Welk Park North subdivision. This work was completed in November 1987.

Floodplain and floodway boundary delineations along the San Diego River from the City of Santee, California, to the confluence of San Vicente Creek were prepared by the San Diego County Department of Public Works. This work, completed in March 1988, and the work completed in 1987, 1986, 1981, 1979, and 1976, accounted for all significant flooding sources affecting the unincorporated areas of San Diego County.

A revised hydraulic analysis for Buena Creek was conducted in 1988. This revision is based on channel improvements between South Santa Fe Avenue and the Atchison, Topeka and Santa Fe Railroad. This revision came in the form of a Best Available Data Letter (BADL) issued on August 30, 1988. The analysis was conducted by Graves Engineering, Inc.

Updated detailed and approximate hydrologic and hydraulic analysis was conducted by WEST Consultants, Inc., for FEMA, under Contract No. EMW-92-C-3804. This restudy was completed in May 1993. Streams studied by detailed methods include: Lawson Valley Creek, Slaughterhouse Creek, Lusardi Creek, Rainbow Creek, Eucalyptus West Branch, Eucalyptus Hills East Branch, Pala Mesa Creek, Tributary to Sweetwater River, Steele Canyon Creek, Gopher Canyon Creek, Forester Creek, Beaver Hollow Creek, Buena Creek, Twin Oaks Valley Creek, Olive Creek, Deer Springs Creek, Stevenson Creek, Coleman Creek, Santa Ysabel Creek, Moosa Creek, Escondido Creek and Witch Creek. Streams studied by approximate methods include: Keys Canyon Creek, Dulzura Creek, Tecate Creek, Potrero Creek, Campo South Creek, Corte Madera Valley Creek, Kit Carson Park Creek, Salt Creek, and Poggi Canyon Creek.

A revised hydraulic analysis for San Luis Rey River from Interstate 15 through the Lake Rancho Viejo Subdivision to just upstream of the Shearer Road was conducted in 1990. This revision came in the form of a BADL issued on December 31, 1990. The analysis was conducted by Graves Engineering, Inc.

City of Carlsbad

The original study was prepared by Dames & Moore, for FEMA under Contract No. C-0542. This work was based on the hydrologic and hydraulic analyses performed by Tetra Tech, Inc., and the California Department of Water Resources for FEMA. This work, which was completed in December 1981, covered all significant flooding sources affecting Carlsbad.

This study has been revised based on a revised hydraulic analysis for a portion of Buena Vista Creek that was performed by George S. Nolte and Associates and submitted to FEMA in June 1986. For this revised study the hydrologic analyses of the coastal areas were performed by Dames & Moore, for FEMA, under Contract No. CMW-C-0970.

Agua Hedionda Creek and Calavera Creek were revised to update the 1-percent annual chance floodplain boundaries and to extend the detailed study of both streams. Agua Hedionda Creek was extended from approximately 0.2 mile downstream of El Camino Real to Oak Lake and to Calavera Creek from the confluence with Agua Hedionda Creek to approximately 0.2 mile upstream of the boundary of the Rancho Carlsbad Mobile Home. This revision was conducted by Ensign & Buckley, for FEMA, under Contract No. EMW-90-C-3133 and was completed in 1995.

City of Chula Vista

The hydrologic and hydraulic analyses were performed by Tetra Tech, Inc., for San Diego Bay, under Contract No. H-4543; the California Department of Water Resources, for Telegraph Canyon Creek and Otay River, under Contract No. H-3947; and the USACE, Los Angeles District, for part of Sweetwater River, under Inter-Agency Agreement No. IAA-H-16-75, Project Order No. 22. This work was completed in December 1981. The hydrologic and hydraulic analyses for Poggi Canyon Creek, Rice Canyon Creek, part of Sweetwater River and Telegraph-Canyon Creek Overflow were performed by George S. Nolte and Associates, for FEMA, under Contract No. EMW-823-C-1163. This work was completed in December 1984.

City of Coronado

The hydrologic and hydraulic analyses for Buena Vista Creek were performed by Dames & Moore, for FEMA, under Contract No. C-0970. This study was completed in June 1986.

City of Del Mar

The hydrologic and hydraulic analyses for the Pacific Ocean were performed by Tetra Tech, Inc., under Contract No. H-4543. A regression analysis was used to supersede the approximate coastal analysis and to update the coastal analysis done by Tetra Tech. This regression analysis was performed by Dames & Moore under Contract No. C-0970.

The hydrologic and hydraulic analyses for Soledad Canyon were performed by the California Department of Water Resources, under Contract No. C-0452. The hydraulic analysis of the San Dieguito River was performed by George S. Nolte and Associates for FEMA under Contract No. EMW-83-C-1163. This work, which was completed in February 1985, covered all significant flooding sources affecting the City of Del Mar.

City of El Cajon

The hydrologic and hydraulic analyses for the City of El Cajon were performed by the USACE, Los Angeles District, for the Federal Insurance Administration under Interagency Agreement No. IAA-H-19-74, Project Order No. 13. This work, which was completed in June 1976, covered all flooding sources affecting the City of El Cajon. Additional analysis for downstream portions of Forester Creek was provided by the San Diego County Department of Sanitation and Flood Control.

City of Encinitas

The hydrologic and hydraulic analyses for Buena Vista Creek and Loma Alta Creek were performed by the California Department of Water Resources and by Tetra Tech, Inc., and under FEMA Contracts H-3947 and H-4543, respectively.

City of Escondido

Additional hydrologic and hydraulic analyses for the City of Escondido were performed by George S. Nolte and Associates, for FEMA, under Contract EMW-83-6-1163. This study was completed in February 1985.

A revised hydraulic analysis for Reidy Creek from Rincon Avenue to the City of Escondido corporate limits was conducted in 1988. This revision came in the form of a BADL issued on May 20, 1988. The analysis was conducted by NBS/Lowry Engineers & Planners.

City of Imperial Beach

The hydrologic and hydraulic analyses for the Tijuana River for the revised study were performed by George S. Nolte and Associates for the City of San Diego, California. This work was completed in July 1985.

In coastal areas, the hydrologic analyses for this study were performed by Dames & Moore, for FEMA, under Contract No. C-0970. This work was completed in June 1986.

Hydrologic and hydraulic analyses of the Otay River were performed by the USACE, Los Angeles District, for FEMA, under Interagency Agreement No. IAA-H-16-75, Project Order No. 17. This work was completed in November 1976. However, this work was superseded by the coastal analyses completed in 1986.

City of La Mesa

Updated hydrologic and hydraulic analyses for Alvarado Creek were performed by the Department of Water Resources, State of California, for the FEMA, under Contract No. EMF-96-CO-0097. This work was completed in March 2000. The floodplain mapping study covers that portion of the incorporated areas of the City of La Mesa from Baltimore Drive downstream 1.5 miles to approximately the eastern city limit.

City of Lemon Grove

The hydrologic and hydraulic analyses for the City of Lemon Grove were performed by George S. Nolte and Associates, the study contractor, for FEMA, under Contract No. EMW-83-6-1163.

City of National City

The original hydrologic and hydraulic analyses for the City of National City were performed by the USACE, Los Angeles District, for FEMA, under Interagency Agreement No. IAA-H-16-75, Project Order No. 22. That work was completed in September 1976.

The hydrologic and hydraulic analyses for La Paleta Creek were performed by the City of San Diego and were completed in 1979. For the revised study, the hydraulic analysis for Sweetwater River upstream of a point approximately 0.6 mile upstream of Interstate 805 was performed by George S. Nolte & Associates, for FEMA, under Contract No. EMW-83-C-1163. This work was completed in December 1984.

The hydrologic analyses of coastal areas were performed by Dames & Moore, for FEMA, under Contract No. C-0970.

City of Oceanside

The original study report was prepared by Dames & Moore for FEMA, under Contract No. C-0542. This work was based on hydrologic and hydraulic analyses for Buena Vista Creek and hydrologic and preliminary hydraulic analyses for Loma Alta Creek performed by the California Department of Water Resources, under Contract No.H-3947, and hydrologic and hydraulic analyses for the Pacific Ocean performed by Tetra Tech, Inc., under Contract No. H-4543. The original study was completed in December 1981.

The hydrologic and hydraulic analyses for the revised study, except the hydrologic analyses for the coastal areas, were performed by George S. Nolte & Associates, for FEMA, under Contract No. EMW-83- C-1163. This work was completed in July 1985.

The hydrologic analyses of the coastal areas were performed by Dames & Moore, for FEMA, under Contract No. C-0970.

A revised hydraulic analysis for a portion of Buena Vista Creek was performed by George S. Nolte and Associates in June 1986.

Updated hydrologic and hydraulic analyses for Pilgrim Creek were conducted by Ensign & Buckley, for FEMA, under Contract No. EMW-90-C-3133. The purpose of this study was to revise the 1-percent annual chance floodplain for Pilgrim Creek from the confluence with the San Luis Rey River to approximately 2.4 miles upstream of the confluence. This study was completed in December 1991 and revised in February 1994.

City of Poway

The hydrologic and hydraulic analyses for the City of Poway were performed by the San Diego County Department of Public Works, for FEMA, under Contract No. C-0970. This study was completed in January 1983.

Updated hydrologic and hydraulic analyses for Pomerado Creek performed by Ensign & Buckley, Consulting Engineers, for FEMA under Contract No. EMW-90-C-9133. This study was completed in 1995.

City of San Diego

The hydrologic and hydraulic analyses for Las Chollas Creek, Wabash Branch, Home Avenue Branch, South Las Chollas Creek, Encanto Branch, Switzer Creek, Florida Drive Branch, Las Puleta Creek, Nestor Creek, Sunrise Overflow, Wabash Tributary, Chollas Reservoir Branch, Radio Drive Tributary, Jamacha Branch, Cadman Street Tributary, Logan Avenue Branch, Goat Canyon Creek, Paradise Creek - North Branch, North Branch Tributary, Valley Road Branch, Curlew Creek, Maple Street Canyon Tributary, Arroyo Drive Tributary, Reynard Way Tributary; and the hydrologic analysis for the Tijuana River were performed by the City of San Diego and were completed in 1979.

Hydrologic and hydraulic analyses for Murray Canyon Creek, Otay River, Rose Canyon Creek, San Clemente Canyon Creek, San Diego River, Tecolote Creek, and Telegraph Creek; and hydrologic and preliminary hydraulic analyses for Carmel Valley Creek, Carroll Canyon Creek, Kit Carson Park Creek, Los Penasquitos Creek, and Soledad Canyon were performed by the California Department of Water Resources for FEMA, under Contract No. H-3947. Final hydraulic analyses for Carroll Canyon Creek, Kit Carson Park Creek, Los Penasquitos Creek, and Soledad Canyon were performed by Dames & Moore under Contract No. H-4834. Hydrologic and hydraulic analyses for the Pacific Ocean, Mission Bay, and San Diego Bay were performed by Tetra Tech, Inc., for FEMA, under Contract No. H-4543. This work was completed in December 1981.

Hydraulic analyses for Murphy Canyon Creek, San Diego River upstream of Friars Road, Santa Ysabel Creek, Santa Maria Creek, the Tijuana River, and Alvarado Canyon Creek were performed by George S. Nolte and Associates, for FEMA, under Contract No. EMW-83-6-1163. The 1985 restudy which was completed in July 1985, along with the work completed in 1979 and 1981, covered all significant flooding sources affecting the City of San Diego.

The upstream portion of Los Penasquitos Creek commencing at the dam just upstream of the confluence with Chicarita Creek has been revised by Rick Engineering in July 1985. Final hydrologic and hydraulic analyses for Carmel Valley Creek were performed by Leedshill Herkenhoff, Inc., in December 1985.

Updated hydrologic and hydraulic analysis for Nestor Creek and the Otay River were prepared by the USACE, Los Angeles District, for FEMA, under Interagency Agreement EMW-89-E-2884, Project Order No. 8. This restudy was completed in December 1989.

Updated hydraulic analysis for South Las Chollas Creek was performed by Mr. John B. Kennaly, P.E. This restudy, which was completed in June 1991, covers an area along South Las Chollas Creek from Interstate Highway 805 to approximately 650 feet upstream of 47th Street.

Updated hydrologic and hydraulic analysis for Alvarado Creek was performed by Borcalli & Associates, Inc., the study contractor, for FEMA, under Contract No. EMF-96-CO-0097. The restudy was completed in April 1998.

City of San Marcos

The hydrologic and hydraulic analyses for the original study were performed by the USACE, Los Angeles District, for FEMA, under Interagency Agreement No. IAA-H-15-72, Project Order No. 14. That study was completed in March 1975.

In December 1986, FEMA authorized a restudy of the City of San Marcos to include areas annexed by the city since the publication for the previous FIS. No new or revised hydrologic or hydraulic analyses were performed for this restudy. Approximate floodplain boundaries along San Marcos Creek and Lake San Marcos were added within the annexed portions of the city, downstream of Discovery Street (U.S. Department of the Army, Corps of Engineers, December 1974).

Updated hydrologic and hydraulic analyses for San Marcos Creek and its tributaries were prepared by Nolte and Associates. The restudy was completed in December 1989.

Updated analyses were performed by Boyle Engineering Corporation for the Woodland Parkway culvert at the upstream limits of San Marcos Creek. Updated analyses were also performed by JBF and Associates, and Dudek and Associates for the Las Posas Road Drainage System. In addition, analyses performed by Landmark Engineering and Stevenson, Porto & Pierce, Inc., were used in delineating the floodway boundaries along short reaches of San Marcos Creek and the Highway 78 Split Flow.

In December 1992, FEMA received the final information required to modify the 1-percent annual chance flood elevations, floodplain boundary delineations, and floodway boundary delineations along Twin Oaks Valley Creek from approximately 2,950 feet upstream of Mission Road to approximately 5,750 feet upstream of La Cienega Road. These modifications were made based on analyses performed by Hunsaker & Associates, Irvine, Inc.

City of Santee

The hydrologic and hydraulic analyses for this study were performed by the San Diego County Department of Public Works.

City of Solana Beach

The hydrologic and hydraulic analyses for the coastal analysis were performed by Tetra Tech, Inc., under Contract No. H-4543. This work was completed in December 1981.

The hydraulic analyses of the San Dieguito River were performed by George S. Nolte and Associates under Contract No. EMW-83-C-1163. This work was completed in February 1985.

City of Vista

The hydrologic and hydraulic analyses for Agua Hedionda Creek, Buena Creek, and the southwestern portion of Buena Vista Creek were performed by the California Department of Water Resources, under Contract No. H-3947. This work was completed in December 1981.

Additional hydrologic and hydraulic analyses for the northwestern portion of Buena Vista Creek were performed by George S. Nolte and Associates, for FEMA, under Contract No. EMW-83-C-1163. This work was completed in January 1985.

Hydrologic and hydraulic analyses for Agua Hedionda Creek were performed by SAAD Consultants for the USACE, Los Angeles District, under Contract No. DACWO9-01-M-0085. This study incorporated new detailed analysis for a previously unstudied portion of Agua Hedionda Creek in the City of Vista, which begins at approximately 200 feet downstream of the confluence of Agua Hedionda Creek and Buena Creek to approximately 1,500 feet downstream of Melrose Drive. This study is approximately 1.25 miles and was completed in June 2002.

In the fall of 2007, severe fires raged throughout San Diego County. In November 2007, HDR Engineering Inc., an IDIQ study contractor for FEMA Region IX under contract number EMF-2003-CO-0045, conducted an emergency task order to assess pre- and post-fire floodplain conditions by approximate methods. Hydrologic and hydraulic analysis for pre-burned conditions were conducted for Portrero Creek, Rainbow Creek, San Luis Rey River and Tributaries, Cottonwood Creek, Dulzura Creek, Bee Canyon Creek, Pringle Canyon Creek, Rattlesnake Canyon Creek, Jaybird Creek, Pauma Creek, Santa Ysabel Creek, Rockwood Creek, Guijito Creek, Santa Maria River, San Dieguito Tributaries, Hatfield Creek, San Vincente Creek and floodplains were incorporated into the raster based countywide Digital Flood Insurance Rate Maps (DFIRM). In the fall of 2010, BakerAECOM removed the San Diego firestorm approximate floodplains that had been incorporated into the countywide DFIRM that was released preliminary in May 2009.

In May 2009, HDR Engineering Inc. converted the vector based countywide Digital Flood Insurance Rate Maps (DFIRM) into a raster based countywide DFIRM. HDR also converted the Base Flood Elevations (BFEs) from National Geodetic Vertical Datum of 1929 (NAVD 29) to the North American Vertical Datum of 1988 (NAVD 88). Letter of Map Changes (LOMCs) listed in Table 5 were also incorporated into the DFIRM. HDR Engineering Inc. was hired as an IDIQ study contractor for FEMA Region IX under contract number EMF-2003-CO-0045, Task Order 18. The countywide FIS was also reformatted and revision descriptions from the past countywide FIS reports were combined into one report.

Planimetric base map information was provided in digital format for FIRM panels. Public Land Survey System (PLSS), information on roads, and political boundaries were provided by SanGIS, Joint Powers Agreement (JPA) between San Diego County and the City of San Diego. National Agricultural Imagery Program (NAIP) aerial imagery was provided by U.S. Department of Agriculture (USDA). Users of this FIRM should be aware that minor adjustments may have been made to specific base map.

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

1.3 Coordination

The following agencies (Table 1 – Contacted Agencies) were contacted for information pertinent to the individual FIS:

TABLE 1: CONTACTED AGENCIES

Boyle Engineering Corporation	California American Water Company
California Coastal Commission	California Department of Transportation
California Department of Water Resources	CH2M HILL, Inc
City of Carlsbad, California	City of Chula Vista, California
City of Imperial Beach, California	City of National City, California
City of Oceanside, California	City of San Diego, California
City of Vista, California	Comprehensive Planning Organization of the San Diego Region
Federal Highway Administration	International Boundary and Water Commission, U.S. Section
Leedshill-Herkenhoff, Inc.	National Oceanic and Atmospheric Administration, Eastern Pacific Hurricane Center
National Oceanic and Atmospheric Administration, National Climatic Center	National Oceanic and Atmospheric Administration, Tide Predictions Branch
National Weather Service, Los Angeles, California	San Diego Coast Regional Commission
San Diego County	San Diego County Department of Sanitation and Flood Control
San Diego Public Library	Scripps Institute of Oceanography
Security Pacific Bank	U.S. Army Corps of Engineers, Coastal Engineering Research Center
U.S. Army Corps of Engineers, Los Angeles District	U.S. Army Corps of Engineers, Waterways Experiment Station
U.S. Department of Defense, Fleet Numerical Weather Center	U.S. Geological Survey

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

For the revised analysis for Pilgrim Creek, within the City of Oceanside, the initial CCO meeting was held on August 22, 1990, and was attended by representatives of the City of Oceanside, the study contractor, and FEMA. The work for this study was completed in December 1991, and modified in February 1994.

For the revised analysis for Nestor Creek and the Otay River, within the City of San Diego, a final coordination meeting held on November 28, 1990, was attended by representatives of the City of San Diego, FEMA, and the study contractor. All issues were resolved.

For the revised analysis for Agua Hedionda Creek and Calavara Creek, within the City of Carlsbad, the initial CCO meeting was held on January 30, 1992, and was attended by, and was attended by representatives of FEMA, the Department of Public Works, the City of Carlsbad, and the study contractor. The work for this study was completed in June 1993 and modified in February 1994. A final CCC meeting was held on February 15, 1995, and was attended by representatives of FEMA, the City of Carlsbad, and the study contractor.

For the 1995 revised analysis for Pomerado Creek, within the City of Poway, the initial CCO meeting was held on January 31, 1992 and attended by representatives of FEMA, the City of Poway, and the study contractor, Ensign & Buckley. An intermediate CCO meeting was held on June 14, 1993, and was attended by representatives of FEMA, the City of Poway, and the study contractor. On February 15, 1995 the results of this study were reviewed at a final CCO meeting attended by representatives of FEMA, the City of Poway, and the study contractor.

For the 1993 revised detailed and approximate analysis for streams, within San Diego County, the final CCO meeting was held on February 15, 1995, and attended by representatives of FEMA, San Diego County, and WEST Consultants, Inc., the study contractor. Detailed analysis streams include: Lawson Valley Creek, Slaughterhouse Creek, Lusardi Creek, Rainbow Creek, Eucalyptus West Branch, Eucalyptus Hills East Branch, Pala Mesa Creek, Tributary to Sweetwater River, Steele Canyon Creek, Gopher Canyon Creek, Forester Creek, Beaver Hollow Creek, Buena Creek, Twin Oaks Valley Creek, Olive Creek, Deer Springs Creek, Stevenson Creek, Coleman Creek, Santa Ysabel Creek, Moosa Creek, Escondido Creek, and Witch Creek. The approximate analysis streams include: Keys Canyon Creek, Dulzura Creek, Tecate Creek, Potrero Creek, Campo South Creek, Corte Madera Valley Creek, Kit Carson Park Creek, Salt Creek, and Poggi Canyon Creek.

For the 1998 revised analysis for Alvarado Creek from its confluence with the San Diego River to the Pennsylvania Lane, within the City of San Diego, the initial CCO meeting was held on September 26, 1996, and attended by representatives of FEMA, the City of San Diego, and the study contractor.

For the 2000 revised analysis for Alvarado Creek, within the City of La Mesa, from Baltimore Drive downstream approximately 1.5 miles to the City of La Mesa corporate limits, the final CCO meeting was held on March 13, 2001. All problems raised at this meeting were addressed during the restudy.

The dates of the initial and final CCO meetings held for San Diego County and the incorporated communities in its boundaries are shown in Table 2, “Initial and Final CCO Meetings.”

TABLE 2: INITIAL AND FINAL CCO MEEETINGS

Community Name	Initial CCO Date	Final CCO Date
San Diego County (Unincorporated Areas)	N/A	July 31, 1986
	N/A	February 15, 1995
Carlsbad, City of	N/A	November 23, 1982
	January 30, 1992	February 15, 1995
Chula Vista, City of	N/A	November 23, 1982 (Otay River)
		November 9, 1984
Coronado, City of	N/A	N/A
Del Mar, City of	N/A	November 8, 1984
El Cajon, City of	N/A	March 11, 1976
Encinitas, City of	N/A	July 17, 1987
Escondido, City of	N/A	November 23, 1982 (Riedy Creek)
	N/A	November 8, 1984
Imperial Beach, City of	N/A	May 24, 1977
	N/A	August 1, 1986
La Mesa, City of	N/A	March 13, 2001
Lemon Grove, City of	N/A	February 5, 1987
National City. City of	N/A	May 29, 1977
Oceanside, City of	N/A	November 22, 1982
	N/A	May 31, 1985 (Garrison Creek/San Luis River)
	August 22, 1990	N/A

N/A- Not Available

TABLE 2: INITIAL AND FINAL CCO MEEETINGS

Community Name	Initial CCO Date	Final CCO Date
Poway, City of	January 31, 1992	February 15, 1995
San Diego, City of	N/A	November 23, 1982
	N/A	May 31, 1985
	N/A	November 28, 1990
	September 26, 1996	N/A
San Marcos, City of	N/A	June 28, 1977
Santee, City of	N/A	November 15, 1983
Solana Beach, City of	N/A	March 18, 1987
Vista, City of	N/A	November 23,1982
	N/A	November 7, 1984

N/A- Not Available

On January 4, 2006, the initial CCO meeting for the San Diego countywide DFIRM and FIS was held. Attending the meeting were representatives of FEMA Region IX, MAPIX-M, HDR Engineering Inc. the study contractor, San Diego County, Cities of Carlsbad, Chula Vista, Coronado, Del Mar, El Cajon, Encinitas, Escondido, Imperial Beach, La Mesa, Lemon Grove, National City, Oceanside, Poway, San Diego, San Marcos, Santee, Solana Beach and Vista.

The final CCO meeting was held on June 25, 2009 to review and accept the results of this FIS. Those who attended this meeting included representatives of FEMA, the study contractor, and the communities.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of San Diego, California, including the incorporated communities listed in Section 1.1. The scope and methodologies used in preparation of this FIS were agreed upon in joint consultation between FEMA and San Diego County. 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.

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

The creeks located in eastern San Diego County in the desert area, namely Box Canyon, Coyote Canyon, Unnamed Canyon, El Vado Canyon, Henderson Canyon, Borrego Palm Canyon, Fire Canyon, Hellhole Canyon, Dry Canyon, and Tubb-Culp Canyon, were studied by the alluvial fan method. All of the above creeks in the desert area were studied from the apex of the alluvial fan down toward the Borrego Sink area.

Flooding caused by the Pacific Ocean (which also affects San Diego Bay and Oneonta Slough) was studied by detailed methods.

Detailed analyses were performed to evaluate flood hazards from shallow flooding in three areas throughout the City of Escondido, designated as “West,”“North,” and “South.” The West areas comprised flooding for Country Club Creek, from the intersection of Gary Lane with Nutmeg Street, downstream to El Norte Parkway (corporate limits). The West areas also included analyses of flooding from the Unnamed Tributary at the intersection of Golden Circle Drive and Country Club Lane, downstream to Country Club Creek. Shallow flooding in the South areas was studied along Citrus Wash from Falconer Road to Ash Street, and along South Midway Wash from Oak Hill Memorial Park Cemetery to its confluence with Citrus hash. North area shallow flooding included analysis of Maywood Wash and Midway Wash. Maywood Wash was studied from La Honda Drive, 2,200 feet north of El Norte Parkway, downstream to Escondido Creek. Midway Wash was studied from El Norte Parkway downstream to Escondido Creek.

The following flooding sources were studied by approximate methods: Alpine Creek, Casa de Oro Creek, Kit Carson Park Creek Tributary, La Orillia Road Tributary, Las Puleta Creek, Los Coches Creek, Moosa Canyon Creek, Murphy Creek, Rice Canyon, a portion of San Diego River, San Dieguito River and Spring Valley Creek.

Kit Carson Park Creek and overflow of Dixon Reservoir from the dam to Escondido Creek were studied by approximate methods.

Approximate methods were used to study the flooding that exists along Federal Boulevard within the corporate limits of the City of Lemon Grove.

Approximate flooding on an unnamed tributary along Avenida Magnifica to Carroll Canyon Creek was deleted due to construction of a large concrete-lined channel which is designed to carry the 1-percent annual chance flood.

Curlew Creek, and its tributaries, Maple Street Canyon and Arroyo Drive, were studied by approximate methods, as were Wabash Tributary and Chollas Reservoir Branch of Las Chollas Creek; Radio Drive Tributary and Cadman Street Tributary of South Las Chollas Creek; Paradise Creek - Valley Road Branch, North Branch, and North Branch Tributary; Logan Avenue Branch of Las Puleta Creek; a portion of Switzer Creek; a portion of Las Puleta Creek; Jamacha Branch of South Las Chollas Creek; Goat Canyon Creek; Reynard Way Tributary; and Alvarado Canyon Creek.

The City of Escondido FIS was revised to incorporate a detailed hydrologic analysis of the channel improvements on Reidy Creek from Lincoln Avenue to Centre City Parkway, and the overflow associated with the culverts at Centre City Parkway. The Special Flood Hazard Area (SFHA) and zone designations were revised as a result of the analysis.

Revised hydraulic analysis was conducted along Reidy Creek from Rincon Avenue to the City of Escondido corporate limits. This revision came in the form of a BADL dated May 20, 1988.

Buena Creek was revised based on channel improvements from South Santa Fe Avenue to Atchison, Topeka and Santa Fe Railroad. This revision came in the form of a BADL dated August 30, 1988.

The Otay River and Nestor Creek were restudied in December 1989 – Otay River from its confluence with San Diego Bay upstream to the confluence of Nestor Creek and Nestor Creek from its confluence with the Otay River to the upstream side of Interstate Highway 5.

The South Las Chollas Creek revision was conducted in 1991. This revision of South Las Chollas Creek was from Interstate Highway 805 to approximately 650 feet upstream of 47th Street.

Revised detailed analysis for Lawson Valley Creek, Slaughterhouse Creek, Lusardi Creek, Rainbow Creek, Eucalyptus West Branch, Eucalyptus Hills East Branch, Pala Mesa Creek, Tributary to Sweetwater River, Steele Canyon Creek, Gopher Canyon Creek, Forester Creek, Beaver Hollow Creek, Buena Creek, Twin Oaks Valley Creek, Olive Creek, Deer Springs Creek, Stevenson Creek, Coleman Creek, Santa Ysabel Creek, Moosa Creek, Escondido Creek and Witch Creek were conducted in May 1993. Approximate analysis for Keys Canyon Creek, Dulzura Creek, Tecate Creek, Potrero Creek, Campo South Creek, Corte Madera Valley Creek, Kit Carson Park Creek, Salt Creek, and Poggi Canyon Creek was also conducted in May 1993.

Pilgrim Creek was revised in February 1994 from the confluence with the San Luis Rey River to approximately 2.4 miles upstream of the confluence.

A revised detailed analysis of Pomerado Creek was conducted in 1995. The stream limits of the revision were from its confluence with Poway Creek to immediately downstream of Glen Oak Avenue within the City of Poway.

San Luis Rey River was revised by a BADL dated December 31, 1990. This revision was from Interstate Highway 15 through the Lake Rancho Viejo Subdivision to just upstream of Shearer Road.

Alvarado Creek from its confluence with San Diego River to the City of San Diego corporate limits was revised in 1996.

Alvarado Creek was revised, within the City of La Mesa, from Baltimore Drive downstream approximately 1.5 miles in March 2000.

In June 2002, Agua Hedionda Creek, within the City of Vista, was revised from approximately 200 feet downstream of the confluence with Agua Hedionda Creek and Buena Creek to approximately 1,500 feet downstream of Melrose Drive. This reach is approximately 1.25 miles.

All or portions of the flooding sources listed in Table 3, “Flooding Sources Studied by Detailed Methods,” were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles and on the FIRM.

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

TABLE 3: FLOODING SOURCES STUDIED BY DETAILED METHODS

Adobe Creek	Agua Hedionda Creek (At City of Carlsbad)	Agua Hedionda Creek (At City of Vista)	Alvarado Creek
Beaver Hollow Creek	Beeler Creek	Broadway Creek	Buena Creek
Buena Vista Creek	Buena Vista Creek Tributary 1	Buena Vista Creek Tributary 3	Calavera Creek
Calavera Creek Split Flow	Carmel Valley Creek	Carroll Canyon Creek	Coleman Creek
County Ditch Creek	Deer Springs Creek	Descanso Creek	Encanto Branch
Escondido Creek (Above Lake Wohlford)	Escondido Creek (At Encinitas)	Escondido Creek (At Escondido)	Escondido Creek (Left Branch)
Eucalyptus Hills (East Branch)	Eucalyptus Hills (West Branch)	Florida Drive Branch	Forester Creek
Garrison Creek	Gopher Canyon Creek	Green Valley Creek	Green Valley Creek Tributary
Harbison Canyon Creek	Hatfield Creek	Home Avenue Branch	Johnson Canyon Creek
Keys Canyon Creek	Keys Canyon Creek Tributary 1	Keys Canyon Creek Tributary 2	Kit Carson Park Creek
Lake & San Marcos Creek	Las Chollas Creek	Las Posas Creek (Upper)	Las Puleta Creek
Lawson Valley Creek	Loma Alta Creek	Los Pensaquitos Creek	Lusardi Creek
McGonigle Canyon Creek	McGonigle Canyon Creek Tributary A	Mexican Canyon Creek	Moosa Creek (North Branch)
Moosa Creek (South Branch)	Murphy Canyon Creek	Murray Canyon Creek	Nestor Creek
North Branch Poway Creek	North Avenue Tributary	North Tributary to Santa Maria Creek	Olive Creek
Otay Creek	Pala Mesa Creek	Paradise Creek	Paradise Creek Valley Road Branch
Pilgrim Creek	Poggi Canyon Creek	Pomerado Creek	Poway Creek
Rainbow Creek (Main Branch)	Rainbow Creek (West Branch)	Rattlesnake Creek	Rattlesnake Creek Split Flow at Heritage Hills
Rattlesnake Creek Split Flow at Midland Road	Reidy Creek	Rice Canyon Creek	Rincon Avenue Tributary
Rose Canyon Creek	Samagutuma Creek	San Clemente Canyon Creek	San Diego River
San Dieguito Creek	San Elijo Creek	San Luis Rey River (At Oceanside)	San Marcos Creek

TABLE 3: FLOODING SOURCES STUDIED BY DETAILED METHODS

San Marcos Creek Highway 78 Split Flow	San Marcos Creek New Study	San Vincente Creek	Santa Maria Creek (San Pasqual Valley Area)
Santa Maria Creek (Santa Maria Valley Area)	Santa Ysabel Creek	Santa Ysabel Creek (Witch Creek)	Slaughterhouse Creek
Soledad Canyon	South Branch Poway Creek	South Fork Moosa Canyon Creek	South Las Chollas Creek
South Tributary to Santa Maria Creek	Steele Canyon Creek	Stevenson Creek	Sunrise Overflow
Sweetwater River (Above Reservoir)	Sweetwater River (Descanso Area)	Sweetwater River (At National City)	Switzer Creek
Tecolote Creek	Telegraph Canyon Creek	Tijuana River	Tributary of South Tributary To Santa Maria Creek
Tributary To Forester Creek	Tributary To Forester Creek (South Branch)	Tributary To Sweetwater River	Twin Oaks Valley Creek
Unnamed Tributary To San Dieguito River	Wabash Branch	Witch Creek	

All or portions of the flooding sources listed in Table 4, “Flooding Sources Studied by Approximate Methods,” were studied by approximate methods. Approximate analyses were used to study only those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and San Diego County.

TABLE 4: FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Alpine Creek	Agua Hedionda Creek	Agua Hedionda Lagoon	Agua Tibia
Bailey Creek	Barrett Lake	Batiquitos Lagoon	Bee Canyon
Borrego Palm Canyon	Borrego Sink	Borrego Sink Wash	Brookside Branch
Buena Vista Creek	Buena Vista Lagoon	Cadman Street Tributary	Campo Creek
Carroll Canyon Creek	Casa de Oro Creek	Chicarita Creek	Chocolate Canyon
Chollas Reservoir Branch	Coleman Creek	Corte Madera Creek	Cottonwood Creek
Coyote Creek	Curlew Creek	Cypress Canyon Creek	Deer Canyon Creek
Dulzura Creek	El Vado Canyon	Encinitas Creek	Escondido Creek
Frey Creek	Garrison Creek	Goat Canyon	Gomez Creek
Gonzales Canyon Creek	Gopher Canyon Creek	Guajome Lake	Guejito Creek
Harbison Canyon Creek	Jamacha Branch	Jaybird Creek	Keys Canyon Creek
Kit Carson Park Creek	Kit Carson Park Creek Tributary	La Orillia Road Tributary	La Zanja Canyon
Lake Henshaw	Lake Hodges	Lake San Marcos	Las Puleta Creek

TABLE 4: FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Little Sycamore Canyon	Los Coches Creek	Los Penasquitos Creek	Lusardi Creek
Maple Street Canyon Tributary	Mataqual Creek	McGonigle Canyon Creek	Miramar Reservoir
Moosa Canyon Creek	Murphy Canyon Creek	Murray Canyon Creek	Murray Creek
Murray Reservoir	North Branch Poway Creek	North Fork Sweetwater River	Oak Canyon
Oak Lake	Opato Creek	Otay River	Pala Creek
Paradise Creek North Branch	Paradise Creek North Branch Tributary	Paradise Creek Paradise Valley Road Branch	Pauma Creek
Pine Valley Creek	Poggi Canyon Creek	Pomerado Creek	Potrero Creek
Radio Drive Branch	Rainbow Creek West Branch	Rice Canyon	Rice Canyon Creek
Rios Canyon Creek	Salt Creek	San Diego River	San Dieguito River
San Dieguito Slough	San Elijo Creek	San Elijo Lagoon	San Luis Rey River
San Marcos Creek	Santa Margarita River	Santa Ysabel Creek	Shaw Valley Creek
Sheperd Canyon	Soledad Canyon	South Fork Alpine Creek	South Fork Moosa Canyon Creek
South Las Chollas Creek	Spring Canyon	Spring Valley Creek	Sweetwater River
Switzer Creek	Sycamore Creek	Tecate Creek	Telegraph Canyon Creek
Tijuana River	Tributary to Forester Creek	Wabash Tributary	Witch Creek

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revisions [LOMR], Letter of Map Revision – based on Fill [LOMR-F], and Letter of Map Amendment [LOMA], as shown in Table 5, "Letter of Map Change."

TABLE 5: LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
San Diego County City of Chula Vista City of National City	Sweetwater River Channelization	4/9/1997	LOMR	97-09-422P
City of San Diego	North & South Tribs. Of Carroll Canyon Creek	6/24/1997	LOMR	97-09-715P
City of San Marcos	San Marcos R.V. Mall - San Marcos Creek, Highway 78 Split Flow	9/15/1997	LOMR	97-09-980P
San Diego County	Channelization and Culverts Along Spring Valley Creek	9/25/1997	LOMR	97-09-648P
San Diego County City of Encinitas	La Bajada Bridge -- Escondido Creek	11/10/1997	LOMR	97-09-1093P

TABLE 5: LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of Poway	Detention Basin North of Glenoak Road; Channel and Culvert Improvements along Pomerado Creek from Glenoak Road to Pomerado Road	11/13/1997	LOMR	97-09-766P
City of Coronado	Coronado Cays - San Diego Bay	12/11/1997	LOMR	98-09-254P
City of San Diego	Renaissance La Jolla - Rose Canyon Creek Tributary	12/19/1997	LOMR	97-09-1042P
City of Poway	Poway Creek from Community Road to Midland Road	1/22/1998	LOMR	96-09-1068P
City of Coronado	Coronado Shore Condo, Highrise Project -- Pacific Ocean	2/10/1998	LOMR	98-09-360P
City of San Diego	Los Penasquitos Creek	2/19/1998	LOMR	98-09-391P
San Diego County City of Vista	Buena Creek	2/26/1998	LOMR	97-09-907P
City of San Marcos	Bay Hill Drive - Twin Oaks Valley Creek	3/5/1998	LOMR	98-09-463P
San Diego County	Broadway Creek	5/13/1998	LOMR	98-09-534P
City of Encinitas	Encinitas Creek	6/16/1998	LOMR	98-09-290P
San Diego County City of Vista	Buena Vista Creek Trib. 1	8/13/1998	LOMR	98-09-413P
City of San Diego	Fairmount Industrial Site - San Diego River	8/24/1998	LOMR	98-09-888P
San Diego County	Casa del Oro Creek Channel Improvements	9/18/1998	LOMR	98-09-851P
City of San Diego	South Bay International Wastewater Treatment Plant - Tijuana River	10/19/1998	LOMR	98-09-843P
City of San Diego	Murphy Canyon Creek	1/25/1999	LOMR	99-09-175P
City of San Diego	Cypress Valley	3/10/1999	LOMR	99-09-325P
City of San Diego	Mission Valley Heights, Lots 4-7	3/16/1999	LOMR	99-09-087P
San Diego County	Lakeside Land Company Property	4/30/1999	LOMR	99-09-179P
City of San Diego	Murphy Canyon Creek	5/25/1999	LOMR	99-09-607P
San Diego County City of El Cajon	4th Street Overflow Area	6/22/1999	LOMR	99-09-441P
San Diego County	Raibow Ridge Subdivision, Tract 459	7/7/1999	LOMR	98-09-1071P
City of Oceanside	A99 Aqueduct Progress Submittal	11/24/1999	LOMR	00-09-019P
City of Coronado	Coronado Cays South Area	12/09/1999	LOMR	99-09-662P

TABLE 5: LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of Escondido City of San Diego	Hodges Golf Improvement Center	1/31/2000	LOMR	99-09-888P
San Diego County City of Santee	Upper San Diego River	2/14/2000	LOMR	99-09-492P
City of Chula Vista	Telegraph Canyon - McMillin Otay Ranch	2/15/2000	LOMR	99-09-1237P
San Diego County City of Lemon Grove	Caltrans Route 125 Sweetwater Road Flood Control Facility	3/27/2000	LOMR	00-09-052P
San Diego County	Cloud Residence	4/3/2000	LOMR	00-09-264P
City of Carlsbad	La Costa Valley	8/22/2000	LOMR	00-09-887P
City of Oceanside	North Avenue (Emerald Estates)	8/25/2000	LOMR	00-09-282P
City of Carlsbad City of Encinitas	La Costa Glen, Formerly Green Valley	9/25/2000	LOMR	99-09-1228P
City of Oceanside	Rancho Del Oro, Unit 1.1	2/6/2001	LOMR	00-09-567P
San Diego County City of El Cajon	Correct Flows Along Madison Channel Tributary to Forester Creek	4/27/2001	LOMR	99-09-1140P
City of Oceanside	Loma Alta Creek	5/31/2001	LOMR	00-09-332P
City of Poway	Trident Center	7/25/2001	LOMR	00-09-080P
City of Carlsbad	Kelly Ranch Village "E"	10/25/2001	LOMR	01-09-204P
City of Chula Vista	Poggi Canyon Storm Drain	11/1/2001	LOMR	01-09-334P
City of Vista	Vista Hacienda	11/7/2001	LOMR	01-09-568P
City of Escondido City of San Diego	Hodges Golf Improvement Center	2/19/2002	LOMR	02-09-498X
City of Poway	Brookview Senior Housing (Parcel 1 of PM 18610)	2/26/2002	LOMR	02-09-286P
City of El Cajon City of Santee	Santee Trolley Extension	3/11/2002	LOMR	99-09-811P
City of Escondido	Adobe Creek Project	4/10/2002	LOMR	01-09-835P
City of Carlsbad	Aqua Hedionada Creek near College Boulevard	8/29/2002	LOMR	02-09-594P
San Diego County City of Chula Vista City of Oceanside City of Poway City of San Diego City of San Marcos City of Vista	Floodway Data Table Corrections	12/17/2002	LOMR	02-09-1364P
San Diego County City of Escondido	Brookside	4/24/2003	LOMR	02-09-714P

TABLE 5: LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of San Diego	Monet Subdivision (Formerly Bryn Glen)	5/1/2003	LOMR	02-09-1505P
City of Poway	French Subdivision	5/29/2003	LOMR	03-09-0026P
City of San Diego	Torrey Glen Subdivison	6/9/2003	LOMR	03-09-0578P
City of San Diego	San Diego River Profile Panel Update	7/8/2003	LOMR	03-09-1082P
San Diego County	Cloud LOMR	7/24/2003	LOMR	03-09-0198P
City of San Marcos	Woodward Street Senior Housing	7/31/2003	LOMR	03-09-0123P
City of San Diego	San Diego Naval Training Center Base Closure & Redevelopment	8/6/2003	LOMR	03-09-1343X
City of San Diego	Valencia Business Park	8/21/2003	LOMR	03-09-0450P
City of San Diego	Tesoro Grove	8/22/2003	LOMR	03-09-0633P
City of San Diego	Santaluz Northeast Affordable Housing Site	11/20/2003	LOMR	03-09-1057P
City of Oceanside	Tract 9796, Sunburst Homes Unit No. 3, Lot 150	11/21/2003	LOMR	02-09-1057P
San Diego County	LOMR for Santa Maria Creek in Ramona	2/19/2004	LOMR	03-09-0999P
San Diego County City of Escondido	Escondido Creek Enhancement Plan	5/21/2004	LOMR	03-09-1334P
City of Chula Vista	Telegraph Canyon Channel - Phase 1	6/11/2004	LOMR	03-09-0900P
City of Oceanside	Buena Vista Creek Near College Boulevard	7/8/2004	LOMR	04-09-0309P
City of San Diego	Vista Sorernto Parkway Bridge	7/15/2004	LOMR	04-09-0108P
San Diego County	Pala Mesa Resort	7/15/2004	LOMR	03-09-1209P
San Diego County City of San Diego	Imperial Marketplace	8/5/2004	LOMR	04-09-0909X
San Diego County	El Apajo Estates	8/12/2004	LOMR	04-09-1186P
City of National City	Paradise Creek - Valley Road Branch LOMR	11/4/2004	LOMR	04-09-1445X
City of Vista	Buena Vista Creek - Vista Village Downtown Development Project	11/26/2004	LOMR	03-09-1498P
City of San Diego	Fenton Carroll Canyon Technology Center	2/10/2005	LOMR	04-09-1311P
San Diego County	Ferry Ranch Flood Control Channel	3/10/2005	LOMR	04-09-1360P
City of Poway	Rattlesnake Creek Restudy	5/5/2005	LOMR	03-09-1583P
City of Chula Vista City of San Diego	Yacoel Properties/Otay River	6/28/2005	LOMR	04-09-1682P
San Diego County	Woods Valley Ranch	10/24/2005	LOMR	04-09-1312P

TABLE 5: LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
San Diego County	Parcel 2 of Parcel Map 13685	11/17/2005	LOMR	05-09-0948P
City of San Diego	River Estates Condominiums	1/30/2006	LOMR	05-09-A470P
San Diego County	Woods Valley Ranch	2/10/2006	LOMR	06-09-B055X
City of San Marcos	Grand Acres	4/27/2006	LOMR	06-09-B556P
City of San Diego	Market Creek Plaza	4/28/2006	LOMR	06-09-B048P
City of San Diego	LOMR for Nestor Creek at Creekside Village	6/22/2006	LOMR	06-09-B001P
City of Carlsbad	La Costa Green	6/30/2006	LOMR	05-09-A482P
City of Carlsbad	Los Coches Village	8/24/2006	LOMR	06-09-B082P
City of La Mesa City of San Diego	Mission Valley East Light Rail Transit	9/5/2006	LOMR	05-09-A362P
City of La Mesa City of San Diego	Mission Valley East Light Rail Transit	9/28/2006	LOMR	06-09-BG31X
San Diego County	Novell Residence	11/29/2006	LOMR	06-09-BF75P
San Diego County	Lake San Marcos and San Marcos Study	2/16/2007	LOMR	07-09-0162X
City of San Marcos	Las Posas Road	2/23/2007	LOMR	06-09-BE72P
City of Poway	Community Road Improvements	4/19/2007	LOMR	06-09-BE88P
City of Vista	Santa Fe Walk (CA)	8/30/2007	LOMR	07-09-0589P
San Diego County City of Carlsbad City of San Marcos	LOMR for San Marcos Creek at University Commons	9/24/2007	LOMR	07-09-1622P
San Diego County	Golden Door Spa	9/27/2007	LOMR	07-09-0601P
City of San Diego	Torrey Ranch Subdivision	12/21/2007	LOMR	07-09-1542P
City of Chula Vista	Eastlake Village Center North	12/27/2007	LOMR	07-09-1325P
San Diego County	Key Canyon Creek at Lilac Ranch	1/17/2008	LOMR	07-09-1709P
City of San Diego	54th and Market	3/27/2008	LOMR	08-09-0291P
City of San Diego	Gold Coast Drive - 96" Pipe (CA)	4/21/2008	LOMR	08-09-0406P
City of San Diego	Pacific Highlands Ranch, San Diego - Gonzales Canyon Creek (CA)	5/30/2008	LOMR	08-09-0467P
City of Vista	Amber Glen	9/5/2008	LOMR	08-09-0596P
City of Chula Vista	Otay River	8/31/2009	LOMR	09-09-1046P

TABLE 5: LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of Vista	Buena Vista Creek	9/04/2009	LOMR	09-09-0724P
City of Chula Vista	Telegraph Canyon Creek	10-2/2009	LOMR	09-09-0757P
San Diego County	Tributary to Sweetwater River	11/19/2009	LOMR	09-09-1604P
San Diego County	San Dieguito River	12/10/2009	LOMR	09-09-3105P
City of Poway	Rattlesnake Creek – Diversion Floodwall at confluence with Poway Creek	4/30/2010	LOMR	10-09-1118P
City of Oceanside	Pilgrim Creek	7/26/2010	LOMR	10-09-1317P

2.2 Community Description

San Diego County is located in the southwest corner of California. It is bounded on the west by the Pacific Ocean, on the north by Riverside County and Orange County, on the east by Imperial County, and on the south by Mexico.

San Diego County has a total area of 4,314 square miles. The population of San Diego County in 2000 was 2,813,833 people (U.S. Census Bureau, 2000). The estimated population in 2007 is 2,974,859 people (U.S. Census Bureau, 2009).

San Diego County has approximately 76 miles of coastline. Much of the coastal plain is elevated and not subject to coastal flooding. Most of the low-lying and densely populated coastal areas lie in and around the City of San Diego.

The climate of the San Diego area is classified as subtropical Mediterranean. Annual rainfall averages 9 to 10 inches a year. The majority of precipitation occurs from December to March. In the summer, rainless periods may extend for as long as 4 months. Temperatures range from an average summer temperature of 75ºF to an average winter temperature of 65ºF.

Agua Hedionda and Buena Creeks are located in the northern part of San Diego County approximately 45 miles from downtown San Diego. Major economic interests adjacent to these creeks consist of chicken ranches and other commercial areas. There are several residential structures located along both streams. Eighty percent of the stream length is under the jurisdiction of San Diego County, while the remainder is within the City of Vista. The drainage area for Agua Hedionda Creek is approximately 6 square miles.

Most of Broadway Creek flows through the City of El Cajon and drains an area of approximately 4.5 square miles. The floodplain of Broadway Creek is ill-defined, and development generally extends to the channel banks in the developed areas.

Carroll Canyon Creek flows westerly through the northern portion of the City of San Diego. Development in the floodplain is sparse. Carroll Canyon drains an area of approximately 18 square miles.

Casa de Oro Creek, a tributary of Spring Valley Creek, flows southwesterly in the Spring Valley area and has drainage area of approximately 3 square miles. The area is composed of a foothill terrain with a long, narrow valley running generally in a north south direction. Rocks in the immediate Spring Valley Creek area are primarily pre-Cenozoic metamorphic rocks, designated as Santiago Peak Volcanics; Black Mountain Volcanics; Bedford Canyon formation; undifferentiated metamorphic rocks; and Quarternary Residuum. The remnants of native vegetation, previously disturbed areas containing successional vegetative growth, and areas of introduced vegetation still provide habitats for numerous species of wildlife.

Descanso Creek flows south-southwesterly to Sweetwater River (near Descanso) and has a drainage area of approximately 6 square miles.

Escondido Creek flows southwest through the west central portion of the county. The basin drains approximately 89 square miles, with topography varying from rugged to gently rolling hills. Escondido Creek flows down a narrow canyon to the City of Escondido corporate limits, where it is contained within a concrete flood-control channel.
Harbison Canyon Creek is a tributary to Sweetwater River. The drainage basin is located between Loveland Reservoir and the City of El Cajon. It drains an area of approximately 10 square miles.

Hatfield Creek lies in the Santa Maria Valley, located approximately 30 miles northeast of the City of San Diego. The central portion of the valley consists of approximately 25 square miles of relative flatland that gives way to rugged foothills on all sides. The valley is bisected by the bed of Santa Maria Creek, which flows only at periods of high runoff during the winter months. The central portion of the valley contains the unincorporated Town of Ramona. Hatfield Creek drains an area of approximately 30 square miles.

Kit Carson Park Creek originates east of the City of Escondido in the foothills and flows southerly into Lake Hodges, in the northeast corner of San Diego County. This stream has a drainage area of approximately 7 square miles.

Mexican Canyon Creek originates north of Jamul and flows westerly along Jamul Drive. Draining 4.7 square miles, Mexican Canyon Creek discharges to the Sweetwater River in Cottonwood Country Club.

North Tributary to Santa Maria Creek is located in the Santa Maria Valley and drains an area of approximately 33 square miles.

Most of the Otay River Valley is located in the unincorporated areas of southern San Diego County. Portions of the floodplain near the mouth are within the corporate limits of the City of San Diego.

The Otay River basin is situated between the Telegraph Canyon and Sweetwater River basins to the north and the Tijuana River basin to the south. The basin has a drainage area of approximately 140 square miles. The upper 99 square miles of area are controlled by Savage Dam, which forms Lower Otay Reservoir, and a smaller dam in Proctor Valley which forms Upper Otay Reservoir.

The Otay River basin is somewhat pear shaped, with a maximum east west length of approximately 25 miles and a maximum width of approximately 10 miles. Elevations range from approximately 3,300 feet at White Mountain to sea level where Otay River flows into the southern end of San Diego Bay. Stream slopes in the area above the reservoirs range from 200 to

300 feet per mile; below Savage Dam, the subbasins have stream slopes ranging from 100 to 400 feet per mile (U.S. Department of the Army, Corps of Engineers, December 1974).

The geology of the area is one of eroded upland surfaces, with numerous short streams, broad mature valleys, and a coastal plain on which marine terraces (locally called mesas) are prominently visible. The higher portions of the basins are underlain by igneous and metamorphic rocks of Pre-Cretaceous age. In the western portion, marine sedimentation of younger ages is encountered. The most recent deposits, mainly sands, silts, and calcarious clays, form a thin cover over uplifted marine terraces and can also be found in the floodplain of many' of the streams (U.S. Department of the Army, Corps of Engineers, December 1974).

Soils in the upper reaches of the basin are rocky, silty loam. They are shallow and poorly developed with high runoff potential. In the stream bottoms and lower portion of Otay Valley, the soils are well-developed sandy loam that can sustain agricultural cultivation. The NRCS has classified this soil as having moderate runoff potential (U.S. Department of the Army, Corps of Engineers, December 1974).

Development of the Otay floodplain downstream of the Interstate Highway 805 bridge is not extensive; however, it does increase. Manufacturing, commercial, and residential encroachment into the floodplain is not extensive at this time with the exception of numerous sand and gravel operations just east of Beyer Way to Hollister Street to the west. Developments in the floodplain downstream of Hollister Street include farms, a mobile home park, and a sewage treatment plant. At the mouth of the Otay River, numerous dikes have been constructed in San Diego Bay to form salt evaporators which are leased by the Western Salt Company.

Although development in the Otay floodplain is light at present, the lower reaches of the study area are under intense pressure for development. These pressures will undoubtedly increase for the entire Otay Valley area as population growth and urban expansion continue to increase.

Reidy Creek originates in the foothills north of the City of Escondido and has a drainage area of approximately 15 square miles before joining with Escondido Creek east of the intersection of Tulip Street and Hale Avenue.

Rice Canyon Creek flows through the eastern section of the City of Chula Vista and discharges into the Sweetwater River near Interstate Highway 805. The flow collects in a natural basin near the eastern study limit and is carried in a large culvert under residential and developing residential areas.

Samagutuma Creek flows westerly to Sweetwater River (Near Descanso) and has a drainage area of approximately 6 square miles.

Santa Maria Creek originates in the mountains above Valley de Los Amigos. The creek flows westerly through the Santa Maria Valley to Bandy Canyon, through which it continues in a northwesterly direction into the San Pasqual Valley where it flows in a dredged channel to its confluence with Santa Ysabel Creek. Elevations range from 380 feet at the confluence to 1,294 feet at the stream gage at the upstream end of Bandy Canyon to 3,279 feet at Witch Creek Mountain. The drainage basin of Santa Maria Creek occupies approximately 57 square miles and is roughly rectangular in shape, being 15 miles long and 4 miles wide within the Santa Maria Valley. The valley is located approximately 30 miles northeast of San Diego and 25 miles inland. The central portion of the valley consists of approximately 25 square miles of relatively flat land that gives way to rugged foothills on all sides. The valley is bisected by the bed of Santa Maria Creek, which flows only at periods of high runoff during the winter months. The central portion of the valley contains the unincorporated Town of Ramona. While the valley is primarily residential and agricultural in nature, there are a number of commercial and industrial activities in Ramona. The general pattern of zoning as established by San Diego County is for agricultural use outside the central area of Ramona and for residential use around that central area. The area immediately to the southeast and southwest of Ramona is zoned for residential use of the type likely to encourage the construction of individual homes. A large portion of the area west of Ramona is zoned for eight 1-acre home sites which, in effect, holds the land open for future changes in land use.

The San Diego River flows westerly through the central portion of the county. The river drains 433 square miles at its mouth in Mission Bay. Sand and gravel operations exist at several locations within the floodplain. The land along the river is used for cultivation, dairy farming, and ranching.

San Vicente Creek flows south from San Vicente Reservoir to San Diego River in the south central portion of the county. The drainage area is approximately 83 square miles.

South Fork Moosa Canyon Creek is located in the northern portion of San Diego County and flows generally north to its confluence with Moosa Canyon Creek. A major development straddling the creek is Lawrence Welk's Country Club Village, Mobile Home Park, and Golf Course.

Floodplain development on South Las Chollas Creek is composed of industrial and commercial development downstream of Interstate Highway 805, residential areas upstream of Interstate Highway 5 on the south bank and upstream of Euclid Avenue, and a mobile home park upstream of 47th Street on the north bank in the City of San Diego. The drainage area is approximately 11 square miles.

South Tributary to Santa Maria Creek and Tributary of South Tributary to Santa Maria Creek are located in the Santa Maria Valley. The drainage area for South Tributary to Santa Maria Creek is approximately 9 square miles.

Spring Valley Creek originates in the La Mesa area east of San Diego and flows southward to join the Sweetwater River below Sweetwater Reservoir. The basin runs in a north-south direction, with a drainage area of approximately 12 square miles. It has a length of approximately 8 miles and an average width of 2 to 3 miles. The highest elevation is 1,373 feet above sea level at Mount Helix, a resistant hillock of the old San Diego Mesa erosion surface. The lowest elevation in the basin is approximately 140 feet at the mouth. The average slope along the longest watercourse is approximately 130 feet per mile.

In Spring Valley, a rapid transformation of rural space into urban space is occurring. Much of the undeveloped upland soil cover is composed of orchards, coastal scrub, and annual grasses. Within the floodplain, residential and commercial development has displaced or significantly modified the natural communities. Numerous trees, (California pepper trees, avocado trees, and olive trees), shrubs, and grasses have been introduced into the floodplain for agricultural and landscaping purposes.

The Sweetwater River drainage area comprises approximately 219 square miles and is elongated in shape. Elevations range from sea level at the mouth of Sweetwater River to approximately 6,500 feet at Cayamaca Peak. The gradient of Sweetwater River ranges from 6 feet per mile near the mouth to approximately 850 feet per mile at the headwaters.

The San Luis Rey River is located in the northern portion of San Diego County and runs generally east to west in a well-defined river bed. The major economic interest in and adjacent to the river is agriculture. Other interests are three golf courses (two major and one minor), an airport, sand and gravel operations, and a dairy. Major concentrations of homes occur around the golf courses. The Pauma Valley Country Club Estates was designed so the houses would be located on either side of the floodplain, which contains a golf course. Other small business and private homes are widely scattered along the river.

The Buena Vista Creek watershed is long and narrow. State Highway 78 abuts the creek for almost the entire study reach. It connects with Interstate Highway 5 on the west and U.S. Highway 395 on the east, facilitating quick transportation and communication between Carlsbad and Oceanside, Vista, San Marcos, Escondido, and communities outside the immediate area. Several highway interchanges have been constructed that traverse the floodplain, such as the one at Jefferson Street and College Boulevard in Carlsbad. These excellent transportation facilities will contribute to increased residential, commercial, and industrial development in the area.

The Poggi Canyon Creek drainage area comprises approximately 4.6 square miles. The creek flows in a steep, well-defined channel through the southeastern section of the City of Chula Vista and discharges into Otay River south of the city. A concrete trapezoidal channel carries the flow through the residential area from Oleander Avenue to a point above Otay Valley Road. In the less developed upper and lower areas, the creek flows in a natural channel.

The Telegraph Canyon Creek drainage area comprises 7.5 square miles and is an elongated area with a length approximately 9 miles and an average width approximately 0.8 mile. The creek originates at an elevation approximately 800 feet and flows generally in a westerly direction through the southern section of the City of Chula Vista to San Diego Bay. In the upper basin of Telegraph Canyon Creek, open space and agricultural land uses predominate. The lower one-third of the basin is highly urbanized; encroachments and developments have highly modified and limited the creek and floodplain vegetative community.

The topography of the City of Coronado is generally low, with elevations ranging from sea level to approximately 23 feet North American Vertical Datum of 1988 (NAVD). The elevation of Highway 75 on the strand is approximately 13 feet. A few areas within the Naval Air Station on the northwestern part of the island reach an elevation of 33 feet. The northern part of the island is sheltered from open ocean waves by the rugged headland of Point Loma, whose elevations reach 300 feet. Serious erosion of beaches, especially of the beaches in the south, is occurring on the island. Actual measured beach erosion rates in Coronado over a 100-year period are estimated to average about 20 feet per year (San Diego County, Department of Sanitation and Flood control, April 1975).

San Diego Bay ranges in depth from 30 to 70 feet in the northern part, 10 to 15 feet in the central bay (except for a 30-foot deep channel and some berthing areas along the eastern margin), and 0 to 8 feet in the south bay (except for several 8- to 20-foot channels) (City of Coronado, Local Coastal Program Policy Group, January 1979). The narrow entrance to San Diego Bay significantly reduces the action of ocean seas and swells upon the enclosed bay waters.

San Dieguito River flows westerly through the northern half of the City of Del Mar just south of the Del Mar racetrack. The river is controlled 9.5 miles upstream by Lake Hodges Dam. Upstream of the dam, the Santa Ysabel River contributes to the San Dieguito drainage. The Santa Ysabel River is controlled 39 miles upstream of Del Mar by the Sutherland Dam. The San

Dieguito watershed is comprised of 347 square miles. The average slope for the approximately 1 mile of river flowing through Del Mar is 3 feet per mile. Soledad Canyon flows westerly just south of the city.

The Forester Creek basin, which includes the City of El Cajon, is characterized by a relatively flat, substantially developed valley floor surrounded by steep undeveloped hillsides. The valley floor generally extends from 350 feet to 550 feet NAVD, while the hillsides vary from 550 feet NAVD to a high elevation of over 1,750 feet NAVD at the ridge. Forester Creek, the main watercourse in the basin, varies in slope from 42 feet per mile in the valley portion to over 300 feet per mile within its steep headwaters above Greenfield Drive.

Forester Creek drains northwest to join the San Diego River near the City of Santee. Notable tributaries to Forester Creek, within the city, are County Ditch Creek, Washington Creek, and Broadway Creek. Floodplains along all streams are ill-defined, and development generally extends to channel banks in the developed portions of the city.

In the City of Escondido, Country Club Creek and its tributary drain a 2.1 square mile watershed on the southwest side of the Merriam Mountains. Development in flood-prone areas consists mostly of single-family homes built around a golf course and country club. Midway and Maywood Washes drain approximately 2 square miles through established residential areas to the north of Escondido Creek. Upstream of their confluence, Citrus and South Midway Wash each drain almost 1 square mile. Established development consists of a mix of single- and multi-family residential home, schools, and commercial buildings. Downstream from their confluence, flood-prone areas are predominantly commercial.

Paradise Creek, a tributary to the Sweetwater River, flows southwesterly through the city of National City. The major portion of National City is in the 5-square mile drainage area of Paradise Creek. The highest elevation in the area is 460 feet NAVD. The gradient of Paradise Creek is approximately 2.5 feet per mile from the mouth to Harbison Avenue and approximately 105 feet per mile from Harbison Avenue to its headwaters. Paradise Creek passes through highly developed areas, and the natural course of the stream has been altered significantly by diversion works designed to convey floodwater away from the center of the city. However, these diversion works lack the capacity to divert major flows.

In addition to the Sweetwater River and Paradise Creek, Creeks A and B flow westerly through the northern part of the City of National City. Creek A flows along the northern corporate limits into the 7th Street Channel. Total drainage area of Creek A is approximately 3 square miles, including the drainage area, approximately 1 square mile, of Creek B. Creek B flows from the eastern corporate limits to its confluence with Creek A near Highland Avenue. Creek A has a gradient of approximately 80 feet per mile. The major obstruction of Creek B is the Interstate Highway 805 crossing, which causes ponding at El Toyon Park. There are some flooding areas related to Creek A, but they are not in National City. The 7th Street Channel is within the San Diego Naval Reservation, which was not studied.

Loma Alta Creek flows westerly through the central part of the City of Oceanside and drains 9.1 square miles.

Garrison Creek flows west-southwesterly through the central part of the City of Oceanside. Small businesses and homes are located adjacent to the creek.

In the City of Poway, a number of residential tracts have already been developed in Poway Valley, particularly along the upper end of Poway Creek after it emerges from the mountainous canyons to the east. Extensive mobile home developments are also located along Poway Creek and on high ground east of Rattlesnake Creek. Where tracts and mobile home parks were developed in the floodplains, the developers were required to provide flood protection. Generally, the creeks in these developments have been confined in moderately sized concrete or earthen channels, and the old stream beds have been graded over for building lots. The result is that approximately one-third of the streams in Poway have been channelized, and the other two-thirds of the valley streams remain in their natural condition.

Large rural-residential areas are located along the central and lower portions of Poway Creek, the central and upper portions of Rattlesnake Creek, and in the hills between Poway and Rattlesnake Creeks. Upper Beeler Creek is relatively undeveloped and will probably remain undeveloped as it forms the boundary of the Camp Elliot Naval Reservation. Substantial agricultural acreage remains in the upper reaches of Poway and Rattlesnake Creeks.

The Green Valley drainage basin is located to the north of the Poway Creek Complex (Poway Creek, Rattlesnake Creek, and Beeler Creek) and just east of the community of Rancho Bernardo. Composed primarily of rural residential development, the basin is approximately 2.3 miles long and 1.9 miles wide, and covers approximately 4.4 square miles.

Green Valley Creek originates in the low rolling hills east of Espola Road near the Poway Reservoir and flows northwest in an unimproved, natural channel to Martincoit Road. The creek continues east in the City of Poway until it enters a concrete trapezoidal channel at the City of San Diego corporate limits. Two small tributaries enter from the northern side at Martincoit Road and Valle Verde Road.

San Marcos Creek flows through the City of San Marcos for a distance of approximately 4 miles. It originates in the coastal range of mountains north and east of the city and eventually empties into Batiquitos Lagoon.

Las Chollas Creek, South Las Chollas Creek, Switzer Creek, Las Puleta Creek, and their tributaries flow through the central portion of the City of San Diego.

The topography of the Las Chollas area consists of a low, relatively flat coastal belt which rises in elevation toward the western foothills of the Laguna Mountains. Localized, steep- sided, meandering canyons with grades in excess of 5 percent are prominent topographic features within the regional drainage basins. The general pattern of drainage flow originates with initial rainfall accumulation in the tributary canyons, where elevations reach 800 feet NAVD. Substantial flows are conveyed to the major flood-control channels, which eventually flow into San Diego Bay.

Development in the floodplain of Las Chollas Creek the City of San Diego consists of industrial development downstream of National Avenue on the east bank, residential development downstream of Market Street on the west bank and upstream of Euclid Avenue on the east bank, and a mobile home park upstream of Fairmont Avenue on the east bank. Medium-density residential development, subject to 1-percent annual chance shallow flooding, exists upstream of Euclid Avenue on Home Avenue Branch.

Wabash Avenue Branch of Las Chollas Creek floodplain includes a commercial area immediately upstream of the State Highway 94 crossing. Upstream of this area, no development has occurred.

Floodplain development on South Las Chollas Creek is composed of industrial and commercial development downstream of Interstate Highway 805, residential areas upstream of Interstate Highway 5 on the south bank and upstream of Euclid Avenue, and a mobile home park upstream of 47th Street on the north bank. An industrial and commercial development upstream of Federal Boulevard is subject to 1-percent annual chance shallow flooding due to inadequate channel improvements upstream of the corporate limits. A residential area upstream of Merlin Drive on the north bank of Encanto Branch is also subject to 1-percent annual chance shallow flooding conditions.

The floodplain of Encanto Branch of South Las Chollas Creek subjects both commercial and low-density residential areas to shallow flooding.

Switzer Creek flows through the fully developed center city business district. It has been improved by the construction of a 10-foot-diameter reinforced concrete pipe. Flow not contained by this pipe will create shallow flooding conditions in the business district.

The floodplain of Florida Drive Branch of Switzer Creek is currently maintained as an open-space area and, as such, contains no development.

Development within the floodplain of Las Puleta Creek consists of residential areas upstream of Interstate Highway 5 and downstream of Interstate Highway 805.

Tijuana River begins at the confluence of Cottonwood Creek and Rio de las Palmas near the City of Tijuana, Mexico. From its origin, it flows northwesterly for approximately 11 miles, passing through the City of Tijuana, to the point where it crosses the international boundary and enters the City of San Diego. North of the boundary, the river turns westerly and flows approximately 6 miles to the ocean.

The Tijuana River drainage basin is roughly triangular in shape and ranges in width from approximately 2 miles near the Pacific Ocean to approximately 50 miles near its eastern boundary. The basin comprises approximately 1700 square miles; approximately 455 square miles are in the United States and approximately 1245 square miles are in Mexico.

Runoff in the Tijuana River watershed is controlled in the United States by the Barrett Dam (built in 1922) and the Morena Dam (built in 1912), and in Mexico by the Rodriguez Dam (built in 1934). The reservoirs were designed as water-conservation facilities and do not have storage capacity for flood-control purposes. The dams are located approximately 33 stream miles, 41 stream miles, and 17 stream miles above the Pacific Ocean, respectively.

The Tijuana River valley is sparsely developed. Most of the valley is utilized for agricultural purposes or as open space in the form of abandoned agricultural lands. Residential and commercial development in the valley is in the eastern half, directly adjacent to Interstate Highway 5. Additionally, sand and gravel mines are being operated at several locations within the floodplain.

Goat Canyon, a tributary to the Tijuana River, has a drainage basin of approximately 4.7 square miles. Approximately 10 percent of the drainage area is within the United States and the remainder is within Mexico. The confluence of Goat Canyon and the Tijuana River is located approximately 1 mile inland from the Pacific Ocean, along the southern bluff.

Land use in Goat Canyon is similar to the un-urbanized areas of the Tijuana River valley. One single-family residential dwelling unit exists near the confluence of Goat Canyon with the Tijuana River.

Considerable residential development has recently occurred in the Sunrise Overflow area.

Nestor Creek is a tributary to Otay River. The confluence of Nestor Creek and Otay River is approximately 1 mile above San Diego Bay. The contributing drainage area of Nestor Creek is approximately 3 square miles. The drainage basin is located entirely within the United States.

The Nestor Creek area is highly urbanized. Current land uses include residential, commercial, and industrial development. Recent development trends have been toward high-density apartment and condominium units. Land use in the low-lying areas, which are subject to frequent flooding, remain primarily agricultural. The agricultural lands are slowly being replaced by urban development.

Los Penasquitos Creek and Carroll Canyon Creek flow westerly through the northern portion of the City of San Diego, forming Soledad Canyon. Carmel Valley Creek is formed by the confluence of drainages from McConigle and Deer Canyons. It flows westerly, joining Soledad Canyon near its outlet to the Pacific Ocean, just south of the City of Del Mar. Soledad Canyon and its tributaries drain approximately 96 square miles. These floodplains are sparsely developed, although some commercial development exists in Soledad Canyon near its confluence withholds Penasquitos Creek.

Murray Canyon Creek flows south along Interstate Highway 805 to its confluence with San Diego River. The reach above Interstate Highway 805 is a deep canyon. Downstream of the canyon area the floodplain gradually widens.

Rose Canyon Creek flows westerly in the upper reaches before turning south above the State Highway 52 crossing. The creek continues along Interstate Highway 5 to its mouth at Mission Bay. Upstream of State Highway 52, the floodplain is relatively narrow and consists almost entirely of undeveloped land (U.S. Department of the Army, Corps of Engineers, July 1970). The lower reaches of Rose Canyon Creek consist of residential areas from the mouth to Interstate Highway 5, and commercial development upstream of Interstate Highway 5.

The studied reach of San Clemente Canyon extends upstream from its confluence with Rose Canyon Creek to Miramar Naval Air Station. San Clemente Canyon Creek flows westerly through San Clemente Canyon Park. State Highway 52 parallels the creek from the Interstate Highway 805 interchange downstream to the confluence with Rose Canyon Creek. The floodplain has an average width of 500 feet (U.S. Department of the Army, Corps of Engineers, July 1970) and, except for San Clemente Canyon Park, is undeveloped.

Tecolote Creek flows southerly through the central portion of the city, draining approximately 9 square miles at its mouth in Mission Bay. A concrete channel begins at Cross Street and terminates downstream of the Atchison, Topeka and Sante Fe Railway bridge. The banks of this channel are elevated by 2 to 4 feet of compacted earth, which provides extra carrying capacity in this channel. A concrete ditch also exists upstream of Diane Avenue.

Murphy Canyon Creek flows southerly parallel to Interstate Highway 15 in the northern portion of the city and enters the San Diego River near the San Diego-Jack Murphy Stadium. Upstream of the corporate limits of San Diego, Murphy Canyon Creek flows through the Miramar Naval

Air Station. Existing land use in Murphy Canyon consists of light industrial development on the canyon floor, with residential development on the mesas. Murphy Canyon is currently undergoing extensive development. The Murphy Canyon Creek watershed is comprised of 12.1 square miles. The average slope for the approximately 1.9 miles of creek flowing through the city is 68 feet per mile. Shepherd Canyon flows into Murphy Canyon Creek at Tierra Santa Boulevard.

2.3 Principal Flood Problems

The southern California coastline is exposed to waves generated by winter and summer storms originating in the Pacific Ocean. It is not uncommon for these storms to cause 15-foot breakers. The occurrence of such a storm event, in combination with high astronomical tides and strong winds, can cause a significant wave run-up and allow storm waves to effect higher-than-normal elevations along the coastline. When this occurs, shoreline erosion and coastal flooding frequently result in damage to inadequately protected structures and facilities located along low-lying portions of the shoreline.

Brief descriptions of several significant storm events are presented to provide historic information on coastal and riverine flood hazards and to compare projected flood depths (California Coastal Commission, December 1978, U.S. Department of Agriculture, September 1939, San Diego Union, G.G. Kuhn and F.P. Shephard, March 1979, and U.S. Department of the Army, Corps of Engineers, San Francisco District and Los Angeles District, 1978).

September 24. 1939

A tropical cyclone, due west of the City of San Diego and moving up the coast towards the City of Los Angeles, caused much damage in San Diego County. Winds ranged from 30 to 60 miles per hour in the coastal communities, and considerable wind damage occurred. Point Loma and Mission Beach were hit particularly hard.

At the City of Oceanside, the fishing pier which is normally 27 feet above the waterline was closed after the waves began smashing over the structure.

December 26, 1940

Mission Beach, Ocean Beach, and Oceanside were the target of a series of high waves riding a high 7.1-foot spring tide on the 26th of December.

The forerunner of the storm was observed from the research ship E.W. Scripps off Baja, California before December 23. Swells from that distant storm were 50 feet high. More than 3.5 inches of rain fell in the City of San Diego on both December 23 and 24. Unusually large breakers began appearing at Oceanside and at Ocean Beach on December 25. On December 26, 20-foot high waves smashed over the beach at Ocean Beach, and imperiled five houses at the foot of Saratoga Avenue. Damage to structures at the foot of Cape May Avenue was also reported. One thousand sandbags were stacked to prevent the surf from undermining foundations of houses. Five hundred tons of rock was placed south of the Mission Beach seawall to break the force of the waves, which sent water surging across Mission Boulevard and into Mission Bay. At Oceanside, high waves were observed breaking over the end of the pier. Erosion at the Wisconsin Street ramp was observed. Sandbags were used to protect El Sereno Court.

Despite the higher tide (7.3 feet) on December 27, the waves had subsided to such an extent that they no longer surged over the Mission Bay seawall.

February 1957

High tides (5.7 feet to 6.9 feet), coupled with storms and winds, undermined homes at nearby Imperial Beach, Mission Beach, and Oceanside.

December 1962

15-foot waves were observed at La Jolla and Coronado.

September 9-10, 1976

Eastern San Diego County was hit hard by tropical storm Kathleen on September 9 and 10, 1976. Rainfall totals for the storm ranged from 1.5 inches on the Pacific Coast, up to 10 inches at Laguna Mountain, and 2.5 to 4.5 inches in the San Diego County desert areas. Intense rainfalls occurred on the eastern slopes of the mountains.

Storm frequency for the county ranged from less than a 50-percent annual chance period on the coast, to more than 1-percent annual chance frequency in the southeast corner of the county.

About $2 million in damage was reported in San Diego County because of tropical storm Kathleen. From Borrego Valley to the Mexican border, extensive sedimentation and erosion occurred in parks, airports, private homes, ranches, and businesses. Roads were severely damaged. Airports were closed at Ocotillo Wells, Agua Caliente, and Jacumba (San Diego County, California, September 1976).

August 15-17, 1977

Severe thunderstorms occurred west of Borrego Valley on August 15, 1977, followed by tropical storm Doreen on August 16 and 17, approximately 60 miles west of the City of San Diego. Rainfall totals were approximately 1.5 to 2 inches along the coast, 3 to 4 inches in mountain areas, and 4 to 5 inches in the desert areas.

Storm frequency for the county ranged from less than a 50-percent annual chance period on the coast, to more than 1-percent annual chance frequency in the desert areas, particularly near Borrego Valley. More than $1.5 million worth of storm damage, mainly in the homes surrounding DeAnza Desert Country Club in Borrego Valley, was reported in San Diego County due to tropical storm Doreen. About 100 homes were damaged with mud flow up to five feet deep.

The most severe flooding occurred on Montezuma Road, where water from Henderson Canyon emerges onto an alluvial fan and the stream patterns are continually shifting down the fan. For many years, the flow has been primarily to the east, with perhaps 10 percent flowing south toward Montezuma Road. This flood changed the main course of the flow toward the south and, therefore, caused heavy flooding in the Montezuma Road area (San Diego County, California, August 1977).

Winter 1977-1978

The entire coastline in San Diego County was hit hard by high storm waves. Damage occurred to private homes as well as to state, city, and county facilities. Private residences located along coastal bluffs between La Jolla and Oceanside were threatened or damaged by wave action. In

Oceanside, 10-foot breakers flooded the first floor of an apartment building and caused $500,000 in damages. Stairs, bulkheads, and rock protection belonging to private residents in Carlsbad were destroyed or damaged by wave action. As much as four vertical feet of beach sand was washed away in some areas. The south jetty in Oceanside lost 30 feet off its end and the entire length was weakened by waves. Total damage was estimated at between $280,000 and $375,000. Approximately 300 feet of the seaward end of the Oceanside Municipal Pier was destroyed, amounting to $450,000 worth of damage. Other smaller amounts of damage caused by wave action occurred at various points along the coastline.

The winter of 1977-1978 drew attention to the fact that severe storms, coupled with intensified rainfall and large waves, may cause more erosion along the coastline in a shorter period of time than erosion during years of normal weathering.

January-February 1980

In the 1980 storms, approximately 15 to 20 inches of precipitation accumulated over approximately six weeks, followed immediately by the storm of February 20-21. During this climax, most county reservoirs peaked and local streams reached maximum levels. Considerable evacuation was necessary, particularly in Lakeside and San Diego-Mission Valley. The Del Mar area was hit hard by the massive spillover from Lake Hodges and 20 beach-front homes had to be evacuated. At Imperial Beach, raw sewage poured at the rate of 10 million gallons a day from a broken pipe in the Tijuana River Valley.

This storm was the most severe since the great storms of 1916 and 1927 for most county areas. A comparison of county rain charts shows that the January 1916 rainfall was almost double the February 1980 rainfall and slightly less than the combined totals for January and February 1980. The rain chart for February 1927 is comparable to the February 1980 chart, although the record rainfall of 12.8 inches at Cuyamaca on February 16, 1927, was not approached.

Three types of storms produce precipitation in the area: general winter storms, general summer storms, and thunderstorms. The storm selected as critical for the watershed, one producing the largest peak discharge, is a high-intensity, three-hour thunderstorm. Runoff from such cloudbursts is characterized by high-peak flows, short-duration flows, and relatively small volumes.

Snow is not considered an important contributory factor to runoff in the area. Also, climatic and drainage area characteristics are not conducive to continuous flow. Consequently, little stream flow occurs, except during and immediately following rains. Runoff increases rapidly in response to rainfall excess.

No major flood problems exist on Agua Hedionda Creek and Buena Creek in the unincorporated areas of San Diego County.

Over bank flood flows on Casa de Oro Creek are caused by debris collected by driveways upstream of Olive Drive and the restricted capacity of culverts located at Troy Street and Olive Drive, as well as limited channel capacity downstream of Mac Lane, at Kenwood Drive, and upstream of Andreen Lane.

The concrete-lined channel for Escondido Creek, from approximately 1,300 feet upstream of Rose Street to 1,300 feet upstream of Harmony Grove Road, does not contain 0.2-percent annual chance flood flows and results in shallow flooding. Downstream of the channel improvement, floodwaters from the 1-percent annual chance flood inundate the sewage treatment plant.

There are no major flooding problems on Otay River. Some areas downstream of Broadway Avenue will be inundated by the 1-percent annual chance flood. A large flood on the Otay River will divide in such a way that the greater portion of the water will flow almost uniformly over the Southern Pacific Railroad embankment, travel 150 feet, and then flow over the perimeter dike into the salt evaporation ponds at the southern end of San Diego Bay. Once the floodwaters pass over the perimeter dike and encounter the asymmetrical maze of interior dikes, weir flow will occur in several directions simultaneously before ultimately flowing back over the dike and into the bay. The smaller portion of the floodwaters will be conveyed the last 2 miles to the San Diego Bay by a partially improved, limited-capacity, soft-bottom channel.

Shallow flooding for the 0.2-percent annual chance event results from limited channel capacity on Reidy Creek downstream of Lincoln Avenue in the City of Escondido.

In the City of Escondido, flooding in the west shallow flooding area is primarily the result of sheet runoff from upland areas. During the 1-percent annual chance event, drainage swales and natural channels are filled beyond capacity. Combined channel overflow and sheet runoff cause ponding at El. Norte Parkway.

Flooding in the north and south shallow flooding areas is caused by 1-percent annual chance sheet runoff that has greater volumes and flow rates than existing storm drains can handle. Excess flows, not conveyed in the storm-drain system, spill down streets and across developed and undeveloped property, and ultimately pond against Escondido Creek channel banks on both the north and south sides of the creek.

Santa Maria Creek flows intermittently; only during periods of heavy rainfall is there any substantial flow. During heavy storms, the creek and its several tributaries are subject to overflow, inundating adjoining properties. As the community of Ramona continues to grow, the overflows will result in greater losses of property. The most serious flood problem in Ramona is caused by a shallow swale, which carries runoff from the low hills at the east end of the town through the central residential section to a southeasterly tributary of Santa Maria Creek. A moderately heavy storm will inundate the streets and homes in the vicinity of this swale. In the San Pasqual Valley, Santa Maria Creek would inundate at least one Fenton Ranch structure in a 1-percent annual chance storm.

There are no records of historical flooding along Carroll Canyon Creek, Descanso Creek, Harbison Canyon Creek, Hatfield Creek, Kit Carson Park Creek, North Tributary to Santa Maria Tributary, Samagutuma Creek, San Vicente Creek, South Tributary to Santa Maria Creek, Sweetwater River (near Descanso), Tributary of South Tributary to Santa Maria Creek, Soledad Canyon, Los Penasquitos Creek, Carmel Valley Creek, Rose Canyon Creek, San Clemente Canyon Creek, Switzer Creek, Florida Drive Branch, Las Puleta Creek, and Murphy Canyon Creek.

Limited culvert capacity on Spring Valley Creek exists at Quarry Road, Sweetwater Road near Jamacha Boulevard, and at Jamacha Road north of Spring Valley Estates. The channel between Lamar Street and Sweetwater Road does not convey the 1-percent annual chance flood. Between Spring Place and Bancroft Drive, the channel is rock-lined and crossed by many bridges that reduce the flow area of the channel by more than 50 percent.

The major cause of flooding along Sweetwater River is long- duration, high-intensity storms. Large floods occurred in the Sweetwater River drainage area in 1825, 1862, 1884, 1916, 1927, and 1937. According to the inhabitants of the area, the flood of 1862 was said to have been the most severe. The 1916 flood caused the wing dike on the right abutment of Sweetwater Dam, which was built in 1888, to fail. The flood of 1927 was almost as large as the 1916 flood.

During the 1977-1978 winter season, several floods occurred on the San Luis Rey River. Erosion and sedimentation occurred in many places, washing out or silting many areas and closing dip section road crossings. The Pauma Valley Country Club experienced major disruptions as a result of water and silt problems. Approximately 40,000 cubic yards of sediment was deposited in the golf course area and expenditures of approximately $30,000 were required because of the flooding problems.

The embankment where Monument Road crosses the San Pasqual Valley, 6.3 miles upstream of the Interstate 15 bridges, washes out in small (less than 10-percent annual chance) floods at the crossing of both Santa Ysabel and Santa Maria Creeks.

The peak flow passing the San Pasqual gage on Santa Ysabel Creek upstream of the San Pasqual Valley was 12,500 cubic feet per second (cfs), a flow with a 0.04 exceedance frequency, corresponding to a 2.5-percent annual chance event. Flow in the San Pasqual Valley was augmented by the overtopping and failure of an earthen dam in Bandy Canyon on Santa Maria Creek. The resulting flow washed out the bridge carrying Bandy Canyon Road across Santa Maria Creek and extensively flooded the valley downstream.

The major watercourses within the Las Chollas study area are Las Chollas Creek and South Las Chollas Creek. Their combined drainage basins encompass approximately 27 square miles. There are few available historical records for Las Chollas Creek and South Las Chollas Creek. Major floods occurred in other San Diego County river basins in 1862, 1884, 1916, 1927, and 1937. Medium-to-small floods occurred in 1889, 1891, 1895, 1906, 1921, 1938, 1941, and 1943. The 1862 flood was probably the largest of record in the county, but the 1916 flood was the most destructive. The 1916 flood caused damage to many important highway and railroad bridges and washed out miles of track and roadbeds. The greatest damage occurred to farmland improvements. Much of the agricultural land was severely damaged. The 1927 flood caused extensive damage to buildings, roads, bridges, utilities, land, and crops in San Diego County.

From available data concerning San Diego River, it is estimated that approximately a 1-percent annual chance frequency flood occurred in 1916 and approximately a 2-percent annual chance frequency flood occurred in 1927. Although no historical records are available for Las Chollas Creek and South Chollas Creek for this period, it is likely that they experienced major floods during these two years.

The 1969 floods caused extensive damage to seven southern California counties adjoining the Los Angeles area. Fortunately for San Diego, only the fringes of the storm passed through the county; most of the damage from these floods occurred in the northern part of the county. Damage occurred on South Las Chollas Creek in the lower reaches when the channel banks collapsed in the vicinity of Oceanview Boulevard crossing. No homes were damaged. The Jackie Robinson YMCA on South Las Chollas Creek suffered damage to its playfield and pool when the flow exceeded the natural channel capacity, which is estimated to be less than the 10-percent annual chance flood. The flow was estimated to be approximately the 10-percent annual chance flood. Flooding also occurred in 1978 and 1979, resulting in extensive flood damage.

Many of the flooding problems in the developed areas are caused by the flow breaking out of the channel at road crossings due to inadequate conveyance structures and debris buildup on the pier walls. Debris accumulation is a particular problem in the upstream reaches of Las Chollas Creek and South Las Chollas Creek, and Paradise Creek, where open brush is the predominant ground cover.

Historically, the Tijuana River valley has been subjected to many severe floods. A storm in 1825 caused severe flooding, and a flood in 1862 was reported to have been the largest flood in the memory of inhabitants at that time. No quantitative records are available for floods prior to 1877. Medium-to-large floods occurred in the drainage area in 1889, 1891, 1895, 1906, 1916, 1921, 1937, 1938, 1941, 1944, and 1980. The greatest rate of runoff in the lower valley measured by gages was 33,500 cfs, which occurred during the February 1980 flood. The most severe flood occurred in 1916, when the flow was estimated at 75,000 cfs. Flood flow rates of 17,000 cfs and 75,000 cfs correspond to 10- and 1-percent annual chance flood flows, respectively.

Due to a protracted drought and the water storage by the dams, surface flows in the lower Tijuana River valley were minimal from 1945 until 1980. The estimated average runoff was approximately 30,000 acre-feet per year for the period 1937-1960. Since 1960, runoff in the lower valley has decreased substantially. From 1960 to 1979, the yearly flow averaged 6,500 acre-feet.

The USACE estimates the in-bank capacity of the natural channel in the Tijuana River valley to be approximately 1,500 cfs. Comparison of this estimated channel capacity with the magnitude of the 10-percent annual chance flood of 17,000 cfs indicates that substantial flooding and damages can be expected frequently in the valley. Damage will include physical damage to structures and improvements, business losses, and interruption of home life and other normal community activities. The February 21, 1980, flood had a discharge of 33,500 cfs, a 2.5- percent annual chance event. It washed out bridges at 19th Street and Dairy Mart Road and changed the river alignment.

Nestor Creek flows through a highly urbanized area. The majority of the less-frequent flood flows are conveyed in the over bank areas, causing considerable inundation of the development within the floodplain. Flood flows on Nestor Creek are significantly restricted at two locations by embankments. One restriction, located 1.7 stream miles above the confluence of Nestor Creek with Otay River, is Interstate Highway 5. The other restriction, located 2.1 stream miles above the confluence, is the San Diego and Arizona Eastern Railroad. Neither of these embankments was designed as a floodwater-retarding structure, but they function as such due to low-capacity culverts.

All runoff from the drainage basin above the freeway enters a retarding pool above the freeway embankment. Water leaves the pool in three directions: (1) through culverts under the freeway; (2) over the center barrier wall of the freeway; and (3) along the freeway alignment. Water crossing over the center barrier wall and under the freeway through the culverts remains within the Nestor Creek drainage basin and continues downstream in Nestor Creek. Flow along the alignment of the freeway is diverted from the Nestor Creek drainage basin northerly to Otay River.

The restriction at the railroad also causes a pool to develop upstream. The storage volume of the pool is adequate to contain the 10-, 2-, and 1-percent annual chance floods. Overtopping of the railroad occurs during the 0.2-percent annual chance flood.

The low-lying lands adjacent to Hollister Street are subject to flooding from both the Tijuana River and Nestor Creek. Flooding is experienced in the area when water-surface elevations in Nestor Creek or the Tijuana River exceed certain elevations. This overflow area diverts water from the Tijuana River into the Nestor Creek during the less-frequent floods, and diverts water from Nestor Creek into the Tijuana River during the more-frequent floods. The overflow area is referred to as Sunrise Overflow.

Diversion of water from Nestor Creek to Tijuana River occurs during the 10-, 2-, and 1-percent annual chance events. The direction of flow in the overflow area is southerly during these floods. The quantity diverted is a significant portion of the Nestor creek runoff, and peak flow rates downstream of the overflow area are reduced accordingly.

Diversion of floodwaters from the Tijuana River to Nestor Creek occurs during the 0.2-percent annual chance event. The direction of flow in the overflow area is northerly during this frequency flood. The quantity of water diverted is insignificant in comparison to the magnitude of the Tijuana River, but it significantly increases the peak flow rate downstream of the-overflow area in Nestor Creek.

The 1978 completion of the Sunrise residential development, at the confluence of the overflow area and Tijuana River, has significantly affected flood flow characteristics in the overflow area. The grading that has taken place elevates the development above the 1-percent annual chance flood elevation for Tijuana River, partial1y blocking the path of flow entering the overflow area. Consequently, this development has reduced the potential for flooding on Nestor Creek due to floodwater diverted from the Tijuana River by the overflow area.

Documentation of historical flooding problems on Nestor Creek downstream of the overflow area from the Tijuana River is based on the conditions that existed prior to completion of the Sunrise development. Historically, the flooding problems have been attributed to floodwaters that overflowed from the Tijuana River.

Historical flood-damage estimates for Nestor Creek downstream of the overflow area are available for the floods of 1916 and 1938. Although the damage estimates for these floods do not represent the damages that would result under present conditions, they do provide indications of the severity of the historical problem. The 1916 flood destroyed most of the improvements in Nestor Creek. Large areas of fertile croplands were covered with debris. Direct losses were estimated by local residents to have exceeded $200,000. In 1938, a flood with a flood flow rate of 6,670 cfs caused damages estimated at $64,000.

Flooding problems along the reach of Nestor Creek, upstream of the overflow area, are caused by runoff from the Nestor Creek drainage basin only. Flooding of a condominium development upstream of the freeway occurs frequently. Flood flows washed out the Union Pacific Railroad bridge over Nestor Creek in 1937. The present embankment was constructed as a replacement for the washed-out railroad bridge.

There are no historical records of flooding along Telegraph Canyon Creek; however, in 1968, the Harbor Side-Castle Park area in the City of Chula Vista experienced considerable flooding. A serious flood problem exists along the lower one-third of Telegraph Canyon Creek, where residential, commercial, and industrial development would be inundated. Approximately 82 percent of the floodplain along the lower one-third of the creek is presently developed for urban uses, with residential usage occupying more than half of the urban area. In the vicinity of Mission Valley Shopping Center, approximately 30 percent (12,000 cfs) of the 1-percent annual chance discharge on San Diego River breaks out of the channel and causes shallow flooding at the shopping center. Shallow flooding also occurs at the Town and Country Hotel area downstream of Fashion Valley Road.

The 0.2-percent annual chance flood on Rose Canyon Creek breaks out of the channel at two locations. The first breakout occurs upstream of the Interstate Highway 5 bridge; the second breakout occurs at the Mission Bay Drive bridge. Approximately 12,000 cfs breaks out at both locations and flows southerly from the Mission Bay Drive bridge through urbanized areas and into Mission Bay.

Both over banks along the concrete channel on Tecolote Creek are subject to 1-percent annual chance flooding because high-flow velocities in the channel may cause erosion to the unprotected earthen banks. Additional flood problems are caused by water ponding upstream of Weeks Avenue and Morena Boulevard.

The concrete ditch upstream of Diane Avenue can convey low flows. During major floods, the culverts at Verley Court and Derrick Drive cannot pass the floodwaters, which results in a breakout along Chateau Drive.

Flooding problems along Murray Canyon Creek are relatively minor. The 1-percent annual chance floodwaters pond behind Friars Road to a depth of 15 feet Floodwaters back up behind Frazee Road bridge at a depth of 8 feet for the 1-percent annual chance flood.

Major floods have occurred along Buena Vista Creek, .as well as in adjacent basins during both the winter and summer, although most of the precipitation occurs between December and March. Rainless periods of several months are common during the summer.

Damaging floods occurred in the region that includes the Buena Vista Creek basin in 1862, 1884, 1895, 1916, 1927, 1932, 1938, and 1942. Little information is available, but indications are that significant inundation occurred in the basin, blocking roads and flooding out farmhouses and crops. Flood damage from such floods has been relatively light because virtually no high-value developments existed on the floodplain during those floods.

Prior to extensive development and improvement of its natural intermittent streams, the City of El Cajon was subject to heavy inundation during large storms. One resident described the use of rowboats for traveling along Main Street during the 1916 flooding in El Cajon. However, due to some protective measures, flooding has been limited to deep water in streets and water seeping into garages, with only minor damage being reported.

The construction of Interstate 8 through the City of El Cajon has created a major hindrance to large flows on County Ditch Creek and Washington Creek. The combined 0.2-percent annual chance flood from these streams will pond to as much as 7 feet deep upstream from the freeway and overtop it in the vicinity of Washington Creek.

Forester Creek’s 0.2-percent annual chance flood would also be hindered from entering the channel, and the excess will flow west along the south side of the freeway from Main Street to the ponding area of Washington Creek as it crosses the freeway to join Forester Creek west of Magnolia Avenue.

Forester Creek will also be hindered in crossing Highway 67, causing backup to the north for the 0.2-percent annual chance flood. This flow will travel north along the Highway 67 embankment, turning west under the highway at the Fletcher Parkway under crossing.

In several cases, there is extensive street flooding in El Cajon due to storm flows exceeding the capacity of storm sewers.

In the downstream reach near San Elijo Lagoon in the City of Encinitas, Encinitas Boulevard and El Camino Del Norte dip sections are subject to overtopping and damage due to flooding from low- return period events similar to the 20- to 10- percent annual chance flood of January 17, 1978 (San Diego County, California, Department of Public Works, October 1980).

The City of Lemon Grove is affected by flood hazards along Spring Valley Creek. In addition, flooding occurs on Federal Boulevard when there is extended heavy rain.

There is no major flood problem from Paradise Creek itself in the City of National City. Minor floods are expected at River Mile 3.6 on Paradise Creek when floods of 1-percent annual chance or greater recurrence intervals occur. The excess water is expected to flow north along the Old Paradise Creek course and rejoin the main flow at River Mile 2.47. Major flooding problems along Paradise Creek occur, however, when the floodwater from the Sweetwater River flows into Paradise Creek. This can occur in two ways: one is by backing up through the Interstate Highway 5 culvert along Paradise Creek; the other is by backing up from the ditch along the Southern Pacific Railroad near West 30th Street. During periods of major flows, the capacity of the Paradise Creek diversion channel will be exceeded. This will result in an area of shallow sheet flow in the vicinity of Las Palmas Park.

Between Interstate Highway 5 and the confluence with the Sweetwater River, there is a swampy area that the City of National City has no intention of developing.

Most of the flood prone areas identified in the City of Poway are a result of inadequate drainage facilities through floodplain developments and at road crossings. The blockage of culverts by sediment and debris, in addition to restricted carrying capacities, would cause backups and over bank flows in several developed areas. Areas that have been identified as those where damage to structures is most probable during a 1-percent annual chance flood event are shown below.

Location	Area of Probable Damage
Poway Creek	
At Confluence Of Poway and Pomerado Creeks	The areas south of Oak Knoll Road north and northwest of the confluence will be inundated by the 1-percent annual chance flood.
At Pomerado Road Bridge	Although the computed water surface at Pomerado Road was lower than the minimum road elevation on pomerado Road, the water-surface elevation 75 feet upstream was 2.4 feet higher. It was assumed that the momentum of the1-percent annual chance flow in the south overbank (approximately 1,800 cfs at 3 feet per second based on the flow distribution) should carry it obver the south approach road in a stream separate from the flow under the bridge. Also, the areas west of Casa Real Unit 4 and north of Tustin Hill Unit 1 lie within the 1-percent annual chance floodplain.
At Community Road	The south overbank areas immediately downstream of Community Road are subject to sheetflow by the 1-percent annual chance natural flood.
At Gate Drive	A 1-percent annual chance flood exceeds the capacity of the culvert at Gate Drive, the approach channel, and the natural channel upstream of it. Overflows are conveyed through the subdivision by Woodgate Place, Gate Drive, and Fairgate Drive. Some houses of low ground elevations will be flooded by the 1-percent annual chance storm.

Location	Area of Probable Damage
At Garden City and Park Poway	Some area in the Garden City and park Poway Subdivisions are inside the 1-percent annual chance flood boundary. These areas are ponded or with low velocity backwater. At the northeast corner of Park Poway Subdivision, minor amounts of flow from North Branch Poway Creek thst do not enter the north-south channel at the eastern boundary may flow west on Garden Road, south on Acton Avenue, west on Biddeford and Saco Streets, and finally rejoin the main flow. Floodwaters from North Branch Poway Creek in the north-south channel east of Park Poway will exceed the channel capacity, overflowing the west bank and flow between the houses on the east side of Acton Street. These flows into Acton Street will continue to Saco and Kittery Streets.
Rattlesnake Creek	
At Heritage Hills	Backwater at the entrance to the concrete-lined channel on the north side of Heritage Hills Unit 4 Subdivision causes1-percent annual chance floodflow to split and travel down the east overbank through open fields, and over parking lots, streets, earth fill (at time of study) storage yards, grass-covered lots. The culvert at Poway road is not capable of carrying the 1-percent annual chance floodflow. This contributes to overbank flow upstream and downstream of Poway Road.
At Midland Road	Between community Road and Midland Road and immediately upstream, many buildings lie within the 1-percent annual chance floodplain.
Between Tierra Bonita Road and Espola Road	Houses south of the channel will be flooded during the 1-percent annual chance storm, because of the inadequate drainage facility at Tierra Bonita Road.
Beeler Canyon Creek Pomerado Road	The Pomerado Road Bridge is inadequate to convey the 1-percent annual chance flow. The head needed to press the flow through the bridge will cause overflow to the north bank and flood a few houses.
Green Valley Creek At Avenida Del Norte	Several homes in Valle Verde Estates downstream of Avenida Del Norte lie within the 1-percent annual chance floodplain. The triple 6 x 3 foot reinforced box culvert is unable to convey the 1-percent annual chance discharge of 2,300 cfs, causing a backup on the north overbank also.
Green Valley Creek Tributary At Green Valley Estates	Downstream of Orchard bend Road, houses adjacent to the creek are subject to 1-percent annual chance flooding.

February 14, 1995

Due to the extensive damage brought by the storm, many local municipalities, including the City of La Mesa, declared local flood emergencies in order to seek State and Federal disaster funds. Documented damage in La Mesa included: flooding of 12 classrooms at Helix High School, the development of a sinkhole 16 feet deep and 5 feet across after an underground pipe on Harbinson Avenue was damaged by floodwaters, and two collapsed storm drains.

Much of the flooding that occurred in the developed areas around Alvarado Creek was due to flow breaking out of the channel at road crossings. Flow breakout was due to low capacity culverts or debris buildup that obstructed flow in the channels and through the culverts. The mobile-home park, which borders Alvarado Creek, experienced flooding twice in 1995. Three feet of water in the park caused mobile homes to start floating downstream. In response to this event, a 3-foot cinder block wall was built in 1995 and has since kept the park from flooding.

2.4 Flood Protection Measures

San Diego County

A reinforced concrete trapezoidal channel has been constructed on Broadway Creek from just west of Victor Street to Oro Street.

An improved flood control channel for Escondido Creek was constructed from 1,300 feet upstream of Rose Street to 1,300 feet upstream of Harmony Grove Road. This channel has the capacity to contain a 1-percent annual chance flood.

For floodplain management purposes, the county has identified the floodplain for the lower 4 miles of Moosa Canyon Creek as an erosion/sedimentation hazard area, and may require that special studies be performed before development is allowed in that area.

There are no flood protection works on Otay River. Lower Otay Dam (Savage Dam) does provide incidental flood protection, although its main purpose is to provide water storage.

An improved channel for Reidy Creek downstream of Lincoln Avenue contains the 1-percent annual chance flood. No other flood-protection measures are known to exist within the county.

There are two privately owned water conservation reservoirs on Sweetwater River. The Sweetwater Reservoir was completed in 1888. This reservoir was breached by the 1916 flood and was rebuilt shortly thereafter. The Loveland Reservoir was completed in 1945. The only major flood-protection work along San Luis Rey River is approximately 2,000 feet of channel with an unlined bottom and riprap bank protection constructed by the California Department of Transportation as part of the Interstate Highway 15 bridge crossing.

There are no known engineering projects installed or planned specifically for protection against coastal flooding. However, within the county, breakwaters and seawalls exist at many places along the shore that are designed to absorb the impact of wave forces. These structures provide protection against excessive beach and berm erosion and function as protection for small craft in harbors. In some instances (e.g., the wall along Strand Way on Mission Beach and the off-shore submerged breakwater under construction at Imperial Beach), structures may also serve as flood-protection measures.

City of Carlsbad

No known engineering projects have been installed or are planned specifically for protection from coastal flooding; however, within the county, breakwaters and seawalls exist at many places along the coast that are designed to absorb the impact of wave forces. These structures provide protection from excessive beach and berm erosion, and function as protection for small craft in harbors. In some instances (e.g., the wall along Strand Way on Mission Beach and the offshore submerged breakwater under construction at Imperial Beach), they may also serve as flood-protection measures.

A section of Buena Vista Creek flows in a concrete-lined channel extending approximately 0.2 mile upstream from Thunder Drive; however, this channel does not have the capacity to carry the 1-percent annual chance flood.

City of Chula Vista

There are no flood-protection works on Otay River. Lower Otay Dam (Savage Dam) does provide incidental flood protection, although its main purpose is to provide water storage.

No Federal flood control facilities exist on Poggi Canyon Creek, Rice Canyon Creek, or Telegraph Canyon Creek; however, local interests have conducted improvement projects that have reduced flood damage. Improvements have consisted of a concrete-lined channel on a reach of Poggi Canyon Creek and a long culvert on a reach of Rice Canyon Creek.

The USACE designed and constructed a project on Lower Telegraph Canyon Creek that extends from the San Diego Bay to east of 4th Avenue. That project is described in a Letter of Map Revision issued December 10, 1991, to the City of Chula Vista.

There are two privately owned water-conservation reservoirs on Sweetwater River. The Sweetwater Reservoir was completed in 1888. This reservoir was breached by the 1916 flood and was rebuilt shortly thereafter. The Loveland Reservoir was completed in 1945.

There are no known engineering projects installed or planned specifically for protection against coastal flooding. However, within the county, breakwaters and seawalls exist at many places along the shore, which are designed to absorb wave forces. These provide protection against excessive beach and berm erosion and function as protection for small craft in harbors. In some instances, the wall along Strand Way on Mission Beach and the off shore submerged breakwater under construction at Imperial Beach may also serve as flood protection measures.

City of Coronado

On the ocean side of the peninsula, a submerged jetty extending south from Zuniga Point on North Island and two Hotel del Coronado jetties were built about 1900. A seawall was constructed in 1905 to protect the shore in front of the Hotel del Coronado from storm surge and wave erosion. That same year, the city constructed the massive rock seawall which extends about one mile along Ocean Avenue. The Coronado Shores area is protected by a rock seawall constructed in 1970. On the bay side, the Coronado Cays residential development on the Silver Strand is protected by more than five miles of bulkhead at an elevation of eight feet above mean higher high water (MHHW), and the residential areas on the head of the peninsula are protected by various types of privately constructed shore-protection structures (Comprehensive Planning Organization of the San Diego Region, September 1978).

Nonstructural flood-protection measures in San Diego County consist of development regulations as required by the California Coastal Act of 1976. The City of Coronado also has a flood-damage- prevention ordinance.

The City of Coronado entered the Regular Phase of the National Flood Insurance Program on June 1, 1982. At that time, no Special Flood Hazard Areas were identified within the community.

City of Del Mar

There are no known engineering projects installed or planned specifically for protection against coastal flooding in the City of Del Mar; however, in the coastal zone within the county, breakwaters and seawalls exist along the shore that are designed to absorb the impact of wave forces. These structures provide protection for small craft in harbors. In some instances, the wall along Strand Way on Mission Beach and the off-shore submerged breakwater under construction at Imperial Beach may also serve as flood-protection measures.

In the riverine zone, Lake Hodges on the San Dieguito River and Sutherland Reservoir on the Santa Isabel River provide incidental flood protection, although their main purpose is to provide water storage.

City of El Cajon

In addition to many culverts under roadways, the city has improved much of its major storm channel system with concrete channel linings and box conduits.

Forester Creek has been improved as a reinforced concrete box conduit from Fletcher Parkway to the extension of Petree Street, and from Arnelle Avenue to Johnson Avenue. A reinforced concrete trapezoidal channel extends from Bradley Avenue to Fletcher Parkway and from Johnson Street to the upstream corporate limits.

County Ditch Creek extends from its underground confluence with Forester Creek to the upstream side of Interstate 8 as a reinforced concrete box conduit. A reinforced concrete trapezoidal channel has been constructed from the freeway to east of Johnson Avenue and from Main Street to Washington Avenue.

Open reinforced concrete channels have been constructed on Washington Creek from its confluence with Forester Creek to Jamacha Road, except for sections of reinforced concrete box conduits from Wisconsin Avenue to Cypress Avenue and from Julian Avenue to Claydelle Avenue.

A reinforced concrete trapezoidal channel has been constructed on Broadway Creek from just west of Victor Street to the study limit at Oro Street.

The city has also constructed various underground collector drain systems. These systems include those existing or now under construction along the streams in the westerly portion of the city that were studied by approximate methods.

City of Encinitas

There are no known engineering projects installed or planned specifically for protection from coastal flooding; however, within the community, breakwaters and seawalls designed to absorb the impact of wave forces exist at many places along the shore. These structures provide protection from excessive beach and berm erosion.

City of Escondido

An improved flood-control channel for Escondido Creek within the corporate limits of Escondido was constructed from El Norte Parkway to a point 1,300 feet upstream of Harmony Grove Road; this channel has the capacity to contain a 1-percent annual chance flood. An improved channel for Reidy Creek downstream of Lincoln Avenue contains the 1-percent annual chance flood. No other flood-protection measures are known to exist within the city.

City of Imperial Beach

Flood-control structures on the Tijuana River consist of approximately 0.5 mile of trapezoidal concrete channel, an energy dissipater, and 2 miles of levees. This is a continuation of a 2.7-mile-long channel constructed in Mexico through the City of Tijuana. These improvements will reduce the floodwater velocity entering the United States at San Ysidro, but will do nothing to alleviate the potential for riverine flooding within the City of Imperial Beach.

The natural source of beach sand that the Tijuana River had historically supplied to the Imperial Beach shoreline has been greatly reduced since 1937, when the Mexican government constructed Rodriguez Dam approximately 14.5 miles southeast of Imperial Beach. It has been estimated that approximately 70 percent of the natural source of sand transported down the river has been cut off as a result of the dam's trapping effect. This situation has caused a serious attrition problem along the city's beachfront, as the river cannot supply a sufficient quantity of sand to offset that lost to the ocean. For an 8-year period (1946-1954), approximately 2.5 million cubic yards of sand were lost offshore. Shoreline erosion left both public and private property in danger of periodic damage from wave action.

Concern over this problem prompted a shore-protection study by the USACE (U.S. Department of the Army, Corps of Engineers, 1940). The immediate result of this study has been the initiation of a sand-replenishment construction contract, which allows for the transportation of sandy material from dredging operations in San Diego Bay to the beachfronts of Coronado and Imperial Beach. Dredging commenced on July 30, 1975, and restoration, as indicated on the topographic maps for the City of San Diego and Imperial Beach (California Coastal Commission, December 1978), is reflected on the Flood Insurance Rate Map. However, the USACE study pointed out that this beach-restoration operation provides only a short-term (5- to 10-year) solution to the problem, unless a series of stabilizing rock groins or underwater offshore breakers are also constructed to complement the new, wider beach. An offshore submerged breakwater is under construction.

City of La Mesa

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

City of Lemon Grove

Presently, the City of Lemon Grove benefits from a system of storm drains.

City of National City

The City of National City has passed and adopted Resolution No. 11976, dated February 17, 1976 (The City of National City, California, February 1976), which provides that when floods occur on the Sweetwater River, sandbags will be placed to prevent flows from entering Paradise Creek from the ditch paralleling the Southern Pacific Railway. The sandbags will be placed perpendicular to Interstate Highway 5, the ditch, and the Southern Pacific Railway, and will be placed to an elevation of 16 feet. The sandbagging is intended to divert the floodwaters west across Interstate Highway 5 and then back into the Sweetwater River.

The maps presented in this study were prepared assuming that the Paradise Creek basin is protected from the 1-percent annual chance floodwater surface level by a sandbag dike. However, any breakdown in this operation (e.g., lack of manpower, lack of mobility, failure of dike control, or any unforeseen circumstance), will cause serious damage to the basin. After the flood threat, the dikes will be removed by the city; therefore, it is considered a temporary flood- protection measure. This emergency flood-protection measure is prepared and ready to implement until the Sweetwater River Flood Control Channel (U.S. Department of the Army, Corps of Engineers, January 1976) is constructed.

There are two privately owned water conservation reservoirs on the Sweetwater River. The Sweetwater Reservoir, at River Mile 9, was completed in 1888. This reservoir was breached by the 1916 flood and was rebuilt shortly thereafter. The Loveland Reservoir, at River Mile 28, was completed in 1945.

The USACE is constructing a flood-control channel (U.S. Department of the Army, Corps of Engineers, January 1976) along the Sweetwater River that will include the entire reach of the river within the corporate limits. The channel is designed to handle the 0.2-percent annual chance flood . This proposed channel was not considered in this report, but, when completed, will change the Sweetwater River overflow considerably.

The Bonita Plaza (Rich Engineering Company, November 1974) is considered in this study. The project includes a proposed rock-lined channel from Bonita Mesa Road to Interstate Highway 805. The channel will tie to the proposed USACE Sweetwater River flood control channel, and will have all of the design dimensions except depth of invert. Thus, the 1-percent annual chance flood will overtop the channel and inundate the parking lot of the plaza. When the USACE project is constructed, the channel will be deepened and the 0.2-percent annual chance flood will be contained within the channel banks.

City of Oceanside

There are no known engineering projects installed or planned specifically for protection against coastal flooding; however, within the county, breakwaters and seawalls exist at many places along the coast that are designed to absorb the impact of wave forces. These structures provide protection against excessive beach and berm erosion and function as protection for small craft in harbors. In some instances (e.g., the wall along Strand Way on Mission Beach and the off-shore submerged breakwater under construction at Imperial Beach), such structures may also serve as flood-protection measures.

Buena Vista Creek has a concrete-lined channel extending approximately 0.2 mile upstream from Thunder Drive; however, this channel does not have the capacity to carry the 1-percent annual chance flood.

Several flood-protection measures have been taken on the San Luis Rey River. At the mouth, a 2,000-foot-long stone groin and rock revetment runs from the beach into the ocean. The rock revetment extends along the northern riverbank from the beach to approximately 500 feet upstream of a railroad bridge. The southern riverbank is protected with rock revetment from the railroad bridge to the Pacific Ocean. In the vicinity of the Oceanside Airport, levees were constructed along the northern and southern banks. Both levees are approximately 4,000 feet long. Bank protection measures have been taken upstream of the Douglas Drive Bridge and the Murray Road Bridge. Stone revetments have been placed along the northern riverbank upstream of the Douglas Drive Bridge, while along the southern bank upstream of the Murray Road Bridge rock has been used to provide 1-percent annual chance flood protection for the surrounding areas.

City of Poway

On Poway Creek, there are manmade drainage channels through Ridgedale, Tustin Hills, and Casa Real Poway upstream of Pomerado Road. The drainage channels in Westgate, Garden City, and Park Poway are not sufficient to carry 1-percent annual chance discharges.

On Rattlesnake Creek, the drainage channel east of Russ Estates is not adequate to contain the 1-percent annual chance discharge. The concrete channel through Heritage is capable of conveying the 1-percent annual chance flow, but not the triple concrete box culvert just downstream under Poway Road. The flow tends to divide before it enters this concrete channel, with over bank flow occurring through the open field to the east.

City of San Diego

The City of San Diego has adopted a zoning ordinance that limits development in flood hazard zones. The city utilizes the floodway and the 0.2-percent annual chance flood as defined by FEMA to delineate the flood zones.

Floodplain management regulations have been adopted by the City of San Diego to regulate development in flood hazard areas. These regulations will aid in the prevention of future flood damages. One objective of the regulations is to elevate the first flood of residential structures above the 1-percent annual chance surface elevation.

There are several graded, trapezoidal, concrete-lined channel banks, culverts, and pipelines along portions of each stream studied in the Las Chollas Valley area. Several of these structures have been constructed to contain the 1-percent annual chance and sometimes the 0.2-percent annual chance flood. However, shallow flooding may occur as a result.

The USACE constructed a flood-control project for the Tijuana River. This project consists of proximately 0.5 mile of trapezoidal concrete channel, an energy dissipater, and 2 miles of levees. It is a continuation of a 2.7-mile-long channel constructed in Mexico through the community of Tijuana. The levee system, which was constructed in 1978 as part of an international agreement between the United States and Mexico, was designed to handle a flow of 135,000 cfs with 2.5 to 3 feet of freeboard. The 1-percent annual chance flow for the Tijuana River is estimated at 75,000 cfs.

The International Boundary and Water Commission (IBWC), United States Section is responsible for the operations and maintenance of the project.

An industrial park exists within the Nestor Creek floodplain immediately downstream of Beyer Way. A 10- by 5-foot reinforced concrete box culvert, constructed within the park, decreases the extent of flooding in the vicinity of the park from the flows on Nestor Creek. The culvert will fully contain the 10- and 2-percent annual chance flood flows, and will contain a significant portion of the 1- and 0.2-percent annual chance flood flows.

Channel improvements for Carmel Valley Creek are in progress or are planned starting at Shaw Valley Road and extending upstream approximately 1 mile. Additional improvements have been proposed for Cannel Valley Creek from downstream of Interstate Highway 5 upstream to Shaw Valley Road.

Chambers Dam is located on Los Penasquitos Creek upstream of Interstate Highway 5. This structure does not affect the magnitude of 1- or 0.2-percent annual chance flood discharges.

There are no flood-protection works on the Otay River. Lower Otay Dam (Savage Dam) provides incidental flood protection, although its main purpose is to provide water storage.

Existing flood-control facilities on Rose Canyon Creek consist of approximately 700 feet of trapezoidal concrete channel under the Interstate Highway 5-State Highway 52 interchange and approximately 1,500 feet of trapezoidal concrete channel between mile 3.78 and mile 4.06. These two concrete channels were constructed and are being maintained by CALTRAN. In addition, there is approximately 500 feet of rock slope protection for the channel at the crossing of Interstate Highway 805.

The City of San Diego has constructed and maintains 250 feet of rock-revetted channel immediately downstream from the Genesee Avenue crossing. A similar channel improvement is at the Regents Road crossing (U.S. Department of the Army, July 1970).

On Murphy Canyon Creek, just upstream of Friars Road, there is an approximately 300-foot long concrete-lined trapezoidal channel downstream of a 1,900-foot long double, 8- by 14-foot reinforced concrete box culvert. Upstream of the double box culvert, there is an additional 600 feet of concrete-lined trapezoidal channel. This lined channel/box culvert structure will fully contain the 10- and 2-percent annual chance flood flows and will contain a major portion of the 1- and 0.2-percent annual chance flood flows. In addition to this structure, CALTRAN, in conjunction with the USACE, has installed a large corrugated metal pipe culvert at the Interstate Highway 15-Murphy Canyon Creek crossing. This corrugated metal pipe culvert restricts the flood flow, thereby causing the upstream valley to act as a detention pond. This detention pond greatly reduces the peak flood flows downstream, and is wholly contained within the Miramar Naval Air Station.

Sutherland Reservoir provides incidental flood protection for Santa Ysabel Creek, although its main purpose is water storage. The City of San Diego is adopting an extensive program of channel widening and maintenance in the San Pasqual Valley on both Santa Ysabel and Santa Maria Creeks by allowing sand and gravel mining in the channels following engineered guidelines (Boyle Engineering Corporation, November 1980, Bement Dainwood Sturgeon Civil Engineers, February, October 1981). The designed improvements consist of excavation of trapezoidal channels of widths from 50 to 400 feet and depths from 5 to 8 feet. A 300- by 8-foot channel begins 4.0 miles upstream of the Interstate 15 bridge on Santa Ysabel Creek and ends 400 feet downstream of Monument Road, where a 400-foot wide channel with armored sides continues to the road, a total distance of 2.3 miles. The upper 2.1 miles of this improved channel will contain the 10-percent annual chance flood. Beginning 1,200 feet upstream of Monument Road, 0.8 mile of a 300- by 5-foot channel is designed to contain the 10-percent annual chance flood. None of the improved sections will contain the 2-percent annual chance or larger floods.

On Santa Maria Creek, the 0.7 mile of channel from the confluence with Santa Ysabel Creek up to Monument road is designed as a 250- by 8-foot trapezoidal channel, with armored sides on the 300-foot- long reach immediately downstream of the road. The channel will contain the 10-percent annual chance flood.

There are no known engineering projects installed or planned specifically for protection from coastal flooding. However, within the county, breakwaters and seawalls exist at many places along the coast that are designed to absorb the impact of wave forces. These structures provide protection from excessive beach and berm erosion and function as protection for small craft in harbors. In some instances, for example, the wall along Stand Way on Mission Beach and the offshore submerged breakwater under construction at Imperial Beach may also serve as flood-protection measures.

City of San Marcos

At the time of the initial study, an improved earthen channel had been constructed near the southwestern corporate limits of the city to control the flow of San Marcos Creek. In addition, the city planned to build a flood control dam near the confluence of San Marcos Creek and the East Branch of San Marcos Creek. That plan has since been abandoned. A citywide master plan of drainage was adopted in 1990.

The Woodland Parkway culvert, which is located at the upstream limits of San Marcos Creek and is approximately 3,485 feet in length, contains the entire 1-percent annual chance flood discharge.

Las Posas Creek is an improved channel from its confluence with San Marcos Creek to approximately 600 feet downstream of Linda Vista Drive. A reinforced concrete box culvert extends from approximately 600 feet downstream of Linda Vista Drive to Grand Avenue. A siltation basin was completed in 1989 at the intersection of Las Posas Road and Avenida Azul. This facility has an insignificant effect on the peak flow rates. Upstream of the siltation basin, Las Posas Creek consists of an underground storm drain system in series with an improved channel.

Twin Oaks Valley Creek has been modified from approximately 2,950 feet upstream of Mission Road to approximately 5,750 feet upstream of La Cienega Road. As a result of these modifications, which include the construction of eight drop structures along the creek, the 1-percent annual chance floodplain is confined within the Twin Oaks Valley Ranch Golf Course.

City of Santee

The Mission Creek channelization project has been completed on the San Diego River. The project is documented in Section 10.3 as a Letter of Map Revision issued to the City of Santee on January 29, 1992.

Forester Creek flood-protection improvements provide 1-percent annual chance flood protection within the City of Santee. The project is documented in Section 10.3 as a Letter of Map Revision issued to the City of Santee on December 24, 2008.

City of Solana Beach

There are no known engineering projects installed or planned specifically for protection against coastal flooding. However, within the City of Solana Beach, breakwaters and seawalls, which are designed to absorb the impact of wave forces, exist at many places along the shore. These structures provide protection against excessive beach and berm erosion.

City of Vista

An improved trapezoidal channel is located approximately 500 feet downstream of State Highway 78 on Buena Creek, and extends for a distance of approximately 600 feet. This portion of the channel has the capacity to carry the 1-percent annual chance flood.

A concrete-lined NRCS trapezoidal channel is located 400 feet upstream of State Highway 78, on Buena Vista Creek, and extends approximately 5,400 upstream. Generally, this channel does not have the capacity to contain the 1-percent annual chance flood flows.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded on the average of once during any 10-, 2-, 1-, or 0.2-percent annual chance period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 2-,1-, and 0.2-percent annual chance 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 that equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

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

Peak discharge-drainage area relationships for all remaining flooding sources studied by detailed methods are shown in Table 8.

The principal source of coastal flooding in San Diego County is from the Pacific Ocean and its landward intrusions such as San Diego Bay, Mission Bay, and the slough near the mouth of the Tijuana River.

Coastal flooding is attributed to the following mechanisms:

1. Swell run up from intense offshore winter storms in the Pacific Ocean

2. Tsunami from the Aleutian-Alaskan and Peru-Chile trenches

3. Run up from wind waves generated by land falling storms

4. Swell run up from waves generated off Baja, California, by tropical cyclones

5. Effects of land falling tropical cyclones

The influence of the astronomical tides on coastal flooding is also incorporated in each of the above mechanisms. A flood-producing event from any of the above mechanisms is considered to occur with a random phase of the astronomical tide. Each of the above mechanisms is considered to act alone; that is, the joint occurrence of any combination of the above mechanisms in a flooding event is considered irrelevant to the determination of flood elevations with return periods of less than 500 years.

For each mechanism, the frequency of occurrence of causative events, as well as the probability distribution of flood elevations at a given location due to the ensemble of events, was determined according to the methodology given in "Methodology for Coastal Flooding in Southern California" (Tetra Tech, Inc., December 1979). A brief outline is presented below.

Winter Swell

The statistics of flooding due to winter swell run up were determined using input data provided by the U.S. Navy Fleet Numerical Weather Center (FNWC). These input data consist of daily values of swell heights, periods, and directions at three deepwater locations beyond the continental shelf bordering the study area. The data span the period 1951 to 1974, and were computed by FNWC using input from ship observations, meteorological stations, and synoptic surface meteorological charts of the Pacific Ocean. For the study, the incoming swell provided by FNWC was classified into 12 direction sectors of 10 degrees band widths each. (Exposure of the study area to winter swells was confined to a 120-degree band, i.e., swell coming from directions 220°T to 340°T). Within each sector, 10 days of swell height and period values were selected from the 24 years of FNWC data to represent extreme flood-producing days. The selection criteria were guided by Hunts formula for run up. The 120 days at each of the three deepwater stations were merged to obtain a master list of 161 extreme run up-producing days. For each of 161 days, the input swell provided by FNWC was refracted across the continental shelf and converted to run up at selected locations in the study area. The techniques used and data required for this are described in Section 3.2. Of the 161 days, a number of groups of consecutive days could be identified.

Each such group of days is considered to represent only one event; the largest run up from each group of days was selected as the maximum run up for that event. As a result of refraction and island sheltering effects, a number of the input swells produced no significant run up at certain locations; therefore, the number of extreme run up events is less than 161. The average number of events in the study area is approximately 40. For each location in the study area, the run up for the extreme events were fitted to a Weibull distribution to obtain a probability distribution of run up from winter swell. The Weibull distribution was found to be best suited for representing run up statistics (Tetra Tech, Inc., December 1979). Because extreme winter swell run up lasts for at least one day, the maximum run up must be considered to coexist with the maximum high tide.

Regarding the extreme run up values as a statistical sample only, the influence of the astronomical tides was included by convolving the probability distribution of run up with the probability distribution of daily high tides. The tatter was obtained from standard tide-prediction procedures (U.S. Department of Commerce, 1941), using the harmonic constants at the nearest available tide gage for which such data exist (supplied by the National Oceanic and Atmospheric Administration (NOAA) Tidal Prediction Branch). At each location, the frequency of occurrence of extreme events is determined by the number of run up values used in the Weibull curve fit. The number of years over which these occur is 24. The product of the frequency of occurrence with the complement of cumulative probability distribution of the run up plus tide (convolved) distribution gives the exceedence frequency curve for flood elevations due to winter swell run up.

Tsunami

Elevation-frequency curves for tsunami flooding were obtained from information supplied by the USACE Waterways Experiment Station (WEE) (U.S. Department of the Army, September 1980). The results of the WES study were interpreted as directed by FEMA.

The statistics of tsunami elevations along the coastline were derived in the WES study by synthesizing data on tsunami source intensities, source dimensions, and frequencies of occurrence along the Aleutian-Alaskan and Peru-Chile trenches. As a result, 75 different tsunamis, each with a known frequency of occurrence, were generated and propagated across the Pacific using a numerical hydrodynamic model of tsunami. At a number of locations in the study area, these 75 tsunami time signatures were each added to the tidal time signature at the nearest tide gage location for which harmonic constants for tide computations are available. One year of tidal signature was generated from the harmonic constants. A given tsunami signature was then combined with the tide signature and the maximum tsunami, plus tide for the combination recorded. To simulate the occurrence of the tsunami at random phases of the tide, the tsunami signature was repeatedly combined with the tide signature starting at random phases over the entire year of tide signature. Each combination produces a maximum tsunami plus tide elevation with frequency of occurrence equal to the frequency of occurrence of the particular tsunami signature used, divided by the total number of such combinations for that particular tsunami. The process was repeated for all 75 tsunami, thus establishing the elevation frequency curve for tsunami flooding.

Wind Waves from Landfalling Storms

The source of data for wind waves is the same as that for winter swell, namely, the FNWC (1951-1974). The stations for which daily height, period, and direction data are available are also the same as for winter swells. The FNWC wind-wave data are directly correlated to local wind speeds. For obtaining run up statistics, the FNWC daily wave data were converted to daily run up data using the method outlined in Section 3.2 (Tetra Tech, Inc., December 1979). The daily run up data were then fitted to a Weibull distribution and convolved with the tide in the same manner as for winter swells.

Tropical Cyclone Swell

Run up from swell generated by tropical cyclones off Baja, California, was computed using the techniques discussed in Section 3.2 (Tetra Tech, Inc., December 1979). To establish the statistics of hurricane swell run up, the following procedure was used. Data concerning tropical cyclone tracks were obtained from the National Climatic Center (NCC). The data comprises 12-hourly positions of eastern North Pacific tropical cyclones from 1949 to 1974. This was supplemented by data on tropical cyclones tracks during the period 1975-1978 reported in various issues of the *Monthly Weather Review* (1976-1979).

Besides position data, storm intensities at each of 12-hourly positions are also given. The intensity classifications are based on estimated maximum wind speeds. The intensity categories are tropical depression (less than 35 knot winds), tropical storm (less than 65 knot winds), and hurricane (at least 65 knot winds). Storms with tropical depression status were considered to generate negligible swell and were omitted from this study. Data on actual maximum wind speeds were available from the NCC only from 1973 to 1977. These data were used as the basis for obtaining values to represent maximum wind speeds from each of the two intensity classifications associated with the track data. Data on storm radii were derived from North American Surface Weather Charts, by analysis of pressure fields of tropical cyclones off Baja, California. These data were used to define the typical radius of maximum winds for each of two relevant intensity classes. For each tropical cyclone between 1949 and 1978, the hurricane wind waves were computed by using the mean radius and maximum wind speeds established for each intensity class, along with the track data. The swell and resultant run up were computed using the techniques described in Section 3.2 (Tetra Tech, Inc., December 1979). For each tropical cyclone and each location of interest in the study area, a time history of swell run up was determined. These were added to time histories of the local astronomical tide in a procedure analogous to that used in determining tsunami-plus-tide effects. The exceedence frequencies of tropical cyclone swell run up were computed in a manner similar to that used for tsunami.

Landfalling Tropical Cyclones

The frequency of land falling tropical cyclones in southern California is extremely low. During the years (1949 to 1974) covered by the NCC tape of eastern North Pacific tropical cyclones, no tropical cyclone hit southern California. A longer period of record was used to estimate the frequency of an event such as the Long Beach 1939 storm. A study by Pyke (Pyke, C.B., October 1972) was used to compile a list of land falling tropical cyc1ones along the coast of southern California. The study was a result of extensive investigations of historical records, such as precipitation and other weather and meteorological data. The study spanned the period from 1889 to 1977 and showed only five or six identifiable land falling tropical cyclones; the 1939 Long Beach event was the strongest and the only one in the tropical storm category. The others were all weak tropical depressions (with maximum winds of less than 35 knots). This low-frequency event (once in 105 years over approximately 360 miles of coastline, coupled with an impact diameter of approximately 60 miles) implies that, for any given location, the return period of a land falling tropical cyclone is approximately 600 years. Therefore, land falling tropical cyclones were not considered in this study.

At each location within the study area, the exceedence frequencies at a given elevation due to the various flood producing mechanisms were summed to give the total exceedence frequency at the flood elevation.

Elevations for floods of the selected recurrence intervals on the Pacific Ocean, Mission Bay, and San Diego Bay are shown in Table 6.

TABLE 6: SUMMARY OF ELEVATIONS

Flooding Source and Location	Elevations (Feet NAVD) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Pacific Ocean				
At La Jolla at Scripps Institute Pier	6.8	7.0	7.2	7.6
At La Jolla at Avienda De La Playa Extended	7.7	8.2	8.4	8.7
At Mission Beach at Crystal Pier	8.1	8.1	8.1	--
At Mission Beach at Pacific Beach Drive Extended	8.0	8.6	8.9	9.5
At Ocean Beach at Saratoga Avenue Extended	7.6	8.3	8.6	9.0
From Northern Corporate Limits of City of Del Mar to Near Mouth of the San Dieguito River	10.6	--	13.9	16.2
At Right Overbank of the Mouth of the San Dieguito River	9.6	--	12.05	14.15
From Mouth of the San Dieguito to 500 feet South of 18th Street	8.4	--	10.2	12.1
From 500 feet South of 18th Street to the Intersection of Ocean Avenue and 15th Street	8.95	--	11.0	13.09
At the Intersection of Ocean Avenue and 15th Street to 10th Street	9.40	--	11.7	13.88
From Just South of 7th Street to 500 feet South of 4th Street	10.55	--	13.74	16.0
From 500 feet South of 4th Street to Southern Corporate Limits of City of Del Mar	10.1	--	12.72	14.9

-- Data Not Available

TABLE 6: SUMMARY OF ELEVATIONS

Flooding Source and Location	Elevations (Feet NAVD)			
	10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Mission Bay				
At Mariners Point	6.1	6.1	6.2	8.6
San Diego Bay				
At Shelter Island	6.4	6.5	7.1	11.1
At City of Chula Vista	6.3	6.5	7.1	11.1
At City of National City	6.9	--	7.9	9.9
Detention Basin 1	--	--	526.1	527.1

-- Data Not Available

For the areas that were not studied using the wave run up model, a regression analysis was developed (Federal Emergency Management Agency, 1984). The regression analysis established wave run up and wave setup elevations at half- mile distances along the shoreline. Computed elevations for wave run up are shown in Table 7.

Flood hydrographs and peak discharges were based on rainfall-runoff hydrograph computations. The flood hydrograph and peak discharge analysis for the 10-,2-,1-, and 0.2-percent annual chance flood computations of the studied streams was performed by Nolte and Associates. The procedure used the basin area, unit hydrograph, soil type, ground cover, antecedent moisture condition, and a storm rainfall pattern to develop a runoff hydrograph. The basin characteristics were computed based on the procedures outlined in the San Diego County Hydrology Manual (San Diego County Flood Control Division, January and October 1983).

The Type B, 24-hour storm rainfall pattern (Figure 11-B-I of the San Diego County Hydrology Manual) (State of California, Department of Water Resources, November 1982) was used to develop runoff hydrographs for the western part of the county. The Type II, 24-hour storm rainfall pattern was used to develop rainfall hydrographs for the eastern part of the county, primarily the Borrego Valley area.

The 10-, 2-, and 1-percent annual chance, 24-hour isopluvials from the San Diego County Hydrology Manual (San Diego County Flood Control Division, January and October 1983) and rainfall records from the California Department of Water Resources (State of California, Department of Water Resources, November 1982) were used to select rainfall amounts for hydrograph computations. The 0.2-percent annual chance rainfall amounts were extrapolated using the 10-, 2-, and 1-percent annual chance rainfall amounts.

Calibration of antecedent moisture conditions (ANC) in the western drainage watersheds was accomplished by analyzing annual peak flows at gagged streams with a log-Pearson Type III analysis (U.S. Water Resources Council, March 1976) to obtain a best fit regarding gage statistics. The ANC values determined by the best-fit procedure were 1.5 for 10-percent annual chance, 2.0 for 2-percent annual chance, 2.5 for 1-percent annual chance, and 3.0 for 0.2-percent annual chance frequencies. These ANC values were also applied to the eastern watersheds. The 1- percent annual chance flow rates at the Borrego Valley area resulting from this set of ANC values were very close to those reported by the county (San Diego County Flood Control Division, January and October 1983).

The hydrologic soil type and the percent and type of ground cover were determined based on information obtained from the soil survey performed for San Diego County (U.S. Department of Agriculture, December 1973).

Within major basins, the hydrographs from separate subbasins were combined and routed downstream using the Muskingum routing procedure.

Discharges for the 10- and 1-percent annual chance floods on Agua Hedionda and Buena Creeks were taken from a 1976 study on Agua Hedionda Creek (San Diego County, California, Department of Sanitation and Flood Control, 1976). Discharges for the 2- and 0.2-percent annual chance floods were taken from a 1972 study on Buena Vista and Agua Hedionda Creeks (U.S. Department of the Army, Corps of Engineers, 1972).

TABLE 7: SUMMARY OF PACIFIC OCEAN WAVE ELEVATIONS

Location	Wave Runup Elevation (Feet NAVD)			Wave Setup Elevation (Feet NAVD)		
	10% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance	10% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Mouth of Batiquitos Lagoon	11.6	15.4	17.9	6.9	7.5	8.6
Just South of Mouth of Batiquitos Lagoon	8.6	10.3	12.4	--	--	--
Shoreline Adjacent to California Western University	15.9	23	26.1	--	--	--
Shoreline Between the Intersections of Hill Street and Cordova Street to the Intersection of Point Loma Avenue and Sunset Cliffs Boulevard	14.1	19.9	22.7	--	--	--
Shoreline Between the Intersections of Loma Point and Sunset Cliffs Boulevard to the Ocean Beach Park Municipal Pier	8.7	10.8	12.7	--	--	--
Shoreline 1,000 feet South of False point	11.57	15.57	18.0	--	--	--
Shoreline North of False Point to the Intersection of Bird Rock Avenue and Dolphine Place	14.3	20.1	23.0	--	--	--
Shoreline from the Intersection of Chelsea Avenue and Caminode La Coasta to a Point about 500 feet North of the Intersection of Caminode La Coasta And La Canada	10.7	14.1	16.4	--	--	--
Shoreline from Palomar Avenue South Approximately 1,500 Feet	9.8	12.5	14.6	--	--	--
Shoreline from Palomar Avenue to Fern Glen	9.2	11.5	13.6	--	--	--
Shoreline from Fern Glen to Pearl Street	8.1	9.7	11.6	--	--	--

-- Data Not Available

TABLE 7: SUMMARY OF PACIFIC OCEAN WAVE ELEVATIONS

Location	Wave Runup Elevation (Feet NAVD)			Wave Setup Elevation (Feet NAVD)		
	10% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance	10% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Shoreline from Whale View Point to Point La Jolla	9.8	12.5	14.7	--	--	--
Shoreline from the Salk Institute to Torrey Pines State Park	8.9	10.9	12.9	--	--	--
1,000 Feet North Along Shore from Pacific Avenue Extended	10.4	13.4	15.7	--	--	--
500 Feet North Along Shore from Pacific Avenue Extended	9.1	10.9	13.2	--	--	--
At Grand Avenue Extended	9.5	11.7	13.9	--	--	--
At Cannon Road Extended	9.3	11.4	13.6	--	--	--
At Cerezo Drive Extended	9.7	12.1	14.2	--	--	--
400 Feet North Along Shore from Manzano Drive Extended	10.3	13.1	15.4	--	--	--
200 Feet North Along Shore from Manzano Drive Extended	10.9	14.1	16.5	--	--	--
Adjacent to Intersection of Carlsbad Boulevard and Palomar Airport Road	11.7	15.5	18.1	--	--	--
Adjacent to Point on Carlsbad Boulevard 0.7 Mile South of Intersection with Palomar Airport Road	8.9	10.8	12.9	--	--	--

-- Data Not Available

TABLE 7: SUMMARY OF PACIFIC OCEAN WAVE ELEVATIONS

Location	Wave Runup Elevation (Feet NAVD) 10% Annual-Chance	Wave Runup Elevation (Feet NAVD) 1% Annual-Chance	Wave Runup Elevation (Feet NAVD) 0.2% Annual-Chance	Wave Setup Elevation (Feet NAVD) 10% Annual-Chance	Wave Setup Elevation (Feet NAVD) 1% Annual-Chance	Wave Setup Elevation (Feet NAVD) 0.2% Annual-Chance
At Poinsettia Lane Extended	11.7	15.4	17.9	--	--	--
At the Shoreline Along Ocean Boulevard	7.7	9.0	10.8	--	--	--
At the Shoreline Along San Diego Bay	--	--	--	6.9	7.9	9.9
At Border State Park	8.0	9.4	11.3	--	--	--
Tijuana River-Oneonta Slough Confluence	--	--	--	6.9	8.2	10.7
300 Feet West of Southern Extent of 1st Street	8.2	9.7	11.6	--	--	--
200 Feet West of 1st Street, 1,400 Feet South of Encanto Avenue	9.0	11.0	13.1	--	--	--
250 Feet West of 1st Street, 500 Feet South of Encanto Avenue	9.3	11.6	13.7	--	--	--
At Encanto Avenue Extended	8.9	10.9	13.0	--	--	--
At Cortez Avenue Extended	8.5	10.2	12.2	--	--	--
At Evergreen Avenue Pier	8.0	9.4	11.3	--	--	--
Along Otay River via San Diego Bay	--	--	--	6.9	7.9	9.9
At Oceanside Harbor	--	--	--	6.9	7.6	9.0
1,000 Feet Northwest of the Mouth of San Luis Rey River, Along Shoreline	9.0	10.9	13.0	--	--	--

-- Data Not Available

TABLE 7: SUMMARY OF PACIFIC OCEAN WAVE ELEVATIONS

Location	Wave Runup Elevation (Feet NAVD)			Wave Setup Elevation (Feet NAVD)		
	10% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance	10% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
1,000 Feet Northwest of the Mouth of San Luis Rey River, Along Shoreline	9.0	10.9	13.0	--	--	--
At Mouth of San Luis Rey River	--	--	--	6.9	7.6	9.0
Shoreward of Intersection of 6th Street and The Strand	9.0	10.9	13.0	--	--	--
1,000 Feet Southeast of Third Street Pier, Along Shoreline	9.7	12.0	14.3	--	--	--
At Mouth of Loma Alta Creek	10.1	12.8	15.1	--	--	--

-- Data Not Available

Peak discharges for Broadway Creek were taken from a Hydrology for Survey Report (U.S. Department of the Army, Corps of Engineers, 1974).

Peak discharges for Casa de Oro Creek and Spring Valley Creek were taken from a 1973 hydrology report (U.S. Department of the Army, Corps of Engineers, June 1973).

Peak discharges for Descanso Creek, Harbison Canyon Creek, Samagutuma Creek, the Sweetwater River, and the Sweetwater River (Near Descanso) were taken from a 1973 hydrology report (U.S. Department of the Army, Corps of Engineers, May 1973).

Discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods on Escondido and Reidy Creeks were taken from previous studies (U.S. Department of the Army, Corps of Engineers, Los Angeles District, November 1971, January 1973, June 1973).

Peak discharges for Hatfield Creek, Kit Carson Park Creek, North Tributary to Santa Maria Creek, Santa Maria Creek (Santa Maria Valley Area), South Tributary to Santa Maria Creek, Tributary of South Tributary to Santa Maria Creek, Wabash Branch and Home Avenue Branch of Las Chollas Creek, South Las Chollas Creek and Encanto Branch, Switzer Creek, Florida Drive Branch, Las Puleta Creek, San Elijo Creek, Loma Alta Creek were computed based on the San Diego County *Hydrology Manual* (San Diego County, Flood Control Division, January and October 1983). This method depends on precipitation, with direct runoff being a function of soil and ground-covers characteristics and also the antecedent moisture condition. Precipitation maps developed by the National Weather Service, along with soil and ground-cover maps established by the NRCS, was used to obtain hydrologic information for these computations. Basin characteristics were confirmed by field reconnaissance. All peak discharges were computed based on existing conditions.

The peak discharges for Las Chollas Creek below Federal Boulevard reflect values obtained by the USACE (U.S. Department of the Army, Corps of Engineers, April 1975) and agreed upon by representatives of San Diego County, the City of San Diego, and the USACE.

The 1-percent annual chance discharge for Otay River was established in 1974 by the USACE and the City of San Diego (U.S. Department of the Army, Corps of Engineers, December 1974). Discharges for the 10-, 2-, and 0.2-percent annual chance floods were determined through coordination between the USACE, the City of San Diego, and San Diego County.

Peak discharges for the 10-,2-,1-, and 0.2-percent annual chance floods on the downstream portions of San Diego River through the City of San Diego were taken from San Diego River Design Memorandum No. 1 (U.S. Department of the Army, Corps of Engineers, July 1975)-. Peak discharges for the 10- and 1-percent annual chance floods on the upstream reaches of San Diego River were taken from *Upper San Diego River Flood Control Investigation* (California Department of Water Resources, February 1976).

Peak discharges for the 10-, 2-, and 1-percent annual chance floods on Santa Maria Creek and Santa Ysabel Creek were taken from the *Flood and Sediment Control Study for the San Pasqual Preliminary Report* (Boyle Engineering Corporation, November 1980). This study used the NRCS methods contained in the computer program TR-20 (U.S. Department of Agriculture, Soil Conservation Service, 1964). Input to the program was determined following the method given in the County of San Diego *Hydrology Manual* (San Diego County, Flood Control Division, January and October 1983). The 0.2-percent annual chance peak floods for these creeks were extrapolated graphically from the values given for smaller floods. In the 2-, 1-, and 0.2-percent annual chance floods, significant spills occur from Santa Ysabel Creek into Santa Maria Creek near Monument Road, a short distance upstream of their confluence.

The 10- and 1-percent annual chance discharges on San Vicente Creek were taken from a 1976 flood-control report (California Department of Water Resources, February 1976). The 2-percent annual chance discharges were computed using the same techniques as in the 1976 flood-control report. The 0.2-percent annual chance discharge was computed based on the San Diego County *Hydrology Manual* (San Diego County, Flood Control Division, January and October 1983).

The discharge-frequency data for the Sweetwater River (near National City) analyses were obtained from the Sweetwater River Flood Control Channel Report (U.S. Department of the Army, Corps of Engineers, January 1976). Peak discharge- frequency relations for floods of the selected recurrence intervals on the Sweetwater River at its mouth were based on the current operating policies of the California American Water Company for Loveland arid Sweetwater Reservoirs (U.S. Department of the Army, Corps of Engineers, January 1976).

Peak discharges for Telegraph Canyon Creek were taken from a 1976 information brochure for flood control on Telegraph Canyon Creek (U.S. Department of the Army, Corps of Engineers, January 1976). The flows for Telegraph Canyon Creek Overflow are from the flows in Telegraph Canyon Creek and the capacity of the culvert under -Interstate Highway 5.

Peak discharges on San Luis Rey River were taken from a California Department of Water Resources report (California Department of Water Resources, unpublished). The 10-percent annual chance discharges between Pauma Creek and Keys Canyon decrease with increasing drainage area due to breakouts from the low flow channel.

Peak discharge-frequency relationships for the Tijuana River were established by the USACE (U.S. Department of the Army, Corps of Engineers, Los Angeles District, 1964). They were determined from U.S. Geological Survey (USGS) records and historical data on Tijuana River and other nearby streams (U.S. Department of the Army, Corps of Engineers, Los Angeles District, 1964). Discharges for Sunrise Overflow were determined in connection with the hydrologic analysis for the Tijuana River.

Peak discharge-frequency relationships for Nestor Creek were determined by utilizing rainfall runoff techniques developed by the NRCS. The NRCS computer program, TR-20, Project Formulation- Hydrology, was used in the analysis (U.S. Department of Agriculture, Soil Conservation Service, 1964).

Peak discharges for the 10-,2-,1-, and 0.2-percent annual chance floods on Soledad Canyon, Los Penasquitos Creek, Carmel Valley Creek, and Carroll Canyon Creek were taken from the 1976 *Hydrology for Flood Insurance Studies, Soledad Canyon and Tributaries, San Diego County. California* (U.S. Department of the Army, Corps of Engineers, April 1976).

Discharges for the 10- and 1-percent annual chance floods on Buena Vista Creek were taken from a 1976 San Diego County Department of Sanitation and Flood Control (DSPC) study on Buena Vista Creek (San Diego County, Department of Sanitation and Flood Control, 1976).

Peak discharges for Carmel Valley Creek restudy were modified to better account for changes in drainage area along the detailed study reach.

Peak discharges for the 10-, 2-, and 1-percent annual chance floods on Murphy Canyon Creek were taken from *Revised Murphy Canyon Peak Discharge Table* (U.S. Department of the Army, Corps of Engineers, September 1980). The 0.2-percent annual chance flood peak was extrapolated graphically from the smaller peaks.

Peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods on Murray Canyon Creek were taken from *Hydrology for Flood Insurance Studies, Murray Canyon Creek, San Diego County, California* (U.S. Department of the Army, Corps of Engineers, July 1978).

Discharges on Murray Canyon Creek decrease in a downstream direction due to two breakouts. Breakouts occur just upstream of the gravel pit area and at the Friars Road overpass.

Discharges on Keys Canyon Creek and tributaries for the 1-percent annual chance flood were gathered from LOMR # 07-09-1709P that was filed for Keys Canyon Creek at Lilac Ranch.

Peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods for Rose Canyon Creek and San Clemente Canyon Creek were taken from the 1972 Hydrology for Flood Plain Information Studies, Rose and San Clemente Canyons (U.S. Department of the Army, Corps of Engineers, 1972).

Discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods on Tecolote Creek were taken from *Hydrology for Flood Insurance Studies, Murphy, Murray, Alvarado, and Tecolote Canyons, San Diego County, California* (U.S. Department of the Army, Corps of Engineers, April 1973). Discharges decrease in a downstream direction at Genesee Avenue and Balboa Avenue due to culvert restrictions.

Discharges for the 2- and 0.2-percent annual chance floods were taken from discharge-frequency curves that were developed from frequency curves for similar gauged streams in the county (U.S. Department of the Army, Corps of Engineers, July 1973). To draw the curve, the Standard Project Flood was calculated using *Generalized Standard Project Rain flood Criteria for Southern California Coastal Streams* (U.S. Department of the Army, Corps of Engineers, March 1967), and routed by the Muskingum method. Discharges used in the hydrologic analysis for the portion of Buena Vista Creek between El Camino Real and Jefferson Street were taken from a 1976 DSFC hydrology report on Buena Vista Creek (San Diego County, Department of Sanitation and Flood Control, 1976).

Flood hydrographs and peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance flood events for Poggi Canyon Creek and Rice Canyon Creek were based on rainfall-runoff hydrograph computations. The procedure used the basin area, unit hydrograph, soil type, ground cover, antecedent moisture condition, and a storm rainfall pattern to develop a runoff hydrograph. The basin characteristics were computed based on the procedures outlined in the San Diego County Hydrology Manual (San Diego County, Flood Control Division, January and October 1983).

The flood flows for the San Dieguito River were taken from a study by Leedshill-Herkenhoff, Inc., for the City of Del Mar (Leedshill-Herkenhoff, Inc., May 1985). They routed the hydrographs developed by Boyle Engineering, Inc., for Santa Ysabel Creek through Lake Hodges Reservoir and down the San Dieguito River to Del Mar. Maximum storage conditions in the Lake Hodges Reservoir were assumed.

The only stream gage in the area is on Forester Creek at Cuyamaca Street and has only a 6-year record. Characteristics of the Forester Creek Drainage Basin were found to be similar to those of the nearby Spring Valley Basin for which frequency-discharge data had previously been published (U.S. Department of the Army, Corps of Engineers, 1974). The slope of the frequency-discharge curve for Spring Valley Creek was, thus, used as typical for the majority of the Forester Creek Basin. The exception is the steep, undeveloped headwaters of Forester Creek upstream from Greenfield Drive. Due to similarities of this area and the upper Murphy Canyon Basin for which frequency-discharge data had been published (U.S. Department of the Army, Corps of Engineers, 1973), the slope of the frequency curve for Murphy Canyon upstream from Clairmont Mesa was used for this area. A hydrologic study of Forester Creek within the City of Santee (Earth Tech, October 1999) was used as a source of 1-percent annual chance peak flow information for floodplain computation along Forester Creek.

Control points for the frequency-discharge curves were developed by calculating the equivalent of a 0.2-percent annual chance flood. A high intensity, 3-hour thunderstorm was selected as critical for the area (U.S. Department of the Army, Corps of Engineers, March 1967). Sub-area hydrographs were developed for the basin by means of the Clark Unit Hydrograph Method (C.O. Clark, 1945) and routed through the drainage system by the Muskingum Method (U.S. Department of the Army, Corps of Engineers, Fort Belvoir Engineering School, 1940), using the HEC-1 computer program (U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, January 1973). The Modified Puls Method (U.S. Department of the Army, Corps of Engineers, Los Angeles District, July 1970) was used to account for heavy ponding upstream from Interstate 8 on County Ditch Creek and Washington Creek.

The discharge-frequency analysis for Paradise Creek was based on the average mean discharge per square mile. This analysis was determined from three, short-term stream gages in the immediate vicinity of Paradise Creek and five selected long-term stream gages in urbanized portions of southern California. The locations of lengths of record for the three short-term stream gages are: Las Chollas Creek at Wabash and Oceanview, 5 years; South Chollas Tributary (Encanto Branch) at Euclid and Market Street, 5 years; and, Spring Valley Creek at Coodland Acres Park, 9 years. The locations and lengths of record for the five long-term stream gages are: Alhambra Wash near Klingerman Street, 42 years; Rubic Wash at Glendon Way, 12 years; Compton Creek at 120th Street, 20 years; Compton Creek near Greenleaf Drive, 34 years; and, Santelle- Westwood Channel near Cuber Boulevard, 20 years. These gages are all located in the Los Angeles area.

The frequency-discharge curve for Paradise Creek was adjusted, as appropriate, to consider diversions at River Mile 3.0 and overflows at River Mile 3.6 of the stream, this resulted in reductions of the peak discharges at downstream concentration points.

Flood hydrographs and peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance flood events for Garrison Creek were based on rain fall- runoff hydrograph computations. The procedure used the basin area, unit hydrograph, soil type, ground cover, antecedent moisture condition, and storm rainfall pattern to develop a runoff hydrograph. The basin characteristics were computed based on .the procedures outlined in a 1983 DSFC hydrology manual (San Diego County, Flood Control Division, January and October 1983).

The Type I, 24-hour storm rainfall pattern (Figure 11-B-I of the 1983 hydrology manual) was used to develop runoff hydrographs.

The 10-, 2, and 1-percent annual chance, 24-hour isopluvials from the 1983 hydrology manual (San Diego County, Flood Control Division, January and October 1983), and rainfall records from the California Department of Water Resources (State of California, Department of Water Resources, November 1982) were used to select design rainfall amounts for hydrograph computations. The 0.2-percent annual chance rainfall amounts were extrapolated using the 10-, 2-, and 1-percent annual chance amounts.

Peak discharges for 1-percent annual chance floods on Beeler Creek, Poway Creek, North Branch Poway Creek, Rattlesnake Creek, and South Branch Poway Creek were taken from *Hydrology Report for Poway Creek Complex* (San Diego County, Department of Sanitation and Flood Control, 1977). Discharges for 10-, 2-, 0.2-percent annual chance recurrence intervals were taken from Hydrology for Flood Insurance Studies, Soledad Canyon and Tributaries. San Diego County, California (U.S. Department of the Army, Corps of Engineers, April 1976). These discharges were determined after extensive coordination among Poway community groups, the USACE, and San Diego County.

The 10- and 1-percent annual chance peak discharges for Green Valley Creek and Green Valley Creek Tributary are based on computation methods explained in the San Diego County *Hydrology Manual* (San Diego County, Flood Control Division, January and October 1983). The county computer programs CN and HYDRO2 were used to perform the numerical computations. The curve numbers (CN) computed by the county are based on the NRCS Hydrologic Soil Group and Ground Cover maps 1969 Edition, and were updated to reflect 1990 land use projections. The 10- and 1-percent annual chance peak flows were obtained using the NRCS Unit Hydrograph and precipitation values obtained from the National Weather Service Precipitation Maps (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, 1973). Field investigations were made to visually verify the 1969 maps, to update for current conditions, and to estimate the subbasin hydrologic conditions and basin factors. An overall fair hydrologic condition exists for the basin on the average.

Using the San Diego County lag definition, lag times and times to peak (Tp) were computed f or each of the subbasins and the entire drainage basin. The basin drainage area, CN, infiltration rate, precipitation, and Tp were input into HYDRO2 and, using the NRCS Unit Hydrograph, a hydrograph was developed for each concentration point resulting in peak discharges. By applying the ratio method to the peak discharges of different recurrence intervals, 2- and 0.2-percent annual chance peak discharges for various concentration points were determined.

Four USGS stream gages are located within the City of Poway. Due to the short period of record, however, they were not utilized in hydrologic analyses.

The method used to develop the San Marcos Creek basin hydrology follows the procedures recommended in the San Diego County *Hydrology Manual* (San Diego County, Flood Control Division, January and October 1983). The standard NRCS unit hydrograph method was applied to Las Posas Creek, San Marcos Creek, and Twin Oaks Valley Creek.

Based on the watershed basin sizes and flow paths of San Marcos and Twin Oaks Valley Creeks, the two creeks have virtually the same time of concentration. Therefore, the peak discharges from the two creeks are additive at their confluence, without significant lag times.

A siltation basin was constructed in the upper portion of the Las Posas Creek watershed at the intersection of Las Posas Road and Avenida Azul. This facility was not included in the hydrologic analyses because the routing effect from the reservoir is insignificant, compared to the overall peak flow rate for Las Posas Creek.

The 1-percent annual chance discharges for the Nestor Creek restudy were developed by the National Resources Conservation Service (NRCS) formerly Soil Conservation Service (SCS) (U.S. Department of Agriculture, Soil Conservation Service, 1964, with updates and Boyle Engineering Corporation, Hydrologic Analysis, 1978.) for the previous FIS, but these values have been changed according to the Leedshill-Herkenhoff, Inc., report published in November 1986

"Nestor Creek Flood Control Master Plan". Due to the construction of "Lot 6 Detention Basin" upstream of the Arizona-Eastern Railroad tracks, the new reduced values have been used for restudy.

The previous FIS showed this reach of the Otay River (from its confluence with the San Diego Bay upstream to the confluence of Nestor Creek) as contained within dirt embankments that were determined to contain only very low flows. The Otay River downstream of Interstate Highway 5 Bridge forms a wide floodplain and flows south of Palm Avenue into the Nestor Creek floodplain. The Otay River flows towards the San Diego Bay by passing between many dirt-compacted dikes which are used to collect sea water to produce salt through evaporation. A thorough field inspection of the salt pond dikes indicates that there is no protective covering on any of these dikes. Without revetment, these earthen dikes will very likely wash out during a 1-percent annual chance discharge of 2,000 cfs on the Otay River. Even with a much lower discharge on the Otay River, during the 1983 storm season these dikes washed out. During a 1-percent annual chance event, the Otay River will break out of its present low flow channel and spread over the area of the salt ponds. Therefore, for all the salt ponds from the abandoned Arizona-Eastern Railroad downstream to the San Diego Bay, the flood hazard zone designations have been changed from Zone X to Zone A to represent their true vulnerability to flooding.

For the February 1995 revision, peak discharges were determined for streams studied by detailed methods using the methods described in the "County of San Diego Hydrology Manual" (County of San Diego Hydrology Manual, 1985). These streams include: Lawson Valley Creek, Slaughterhouse Creek, Lusardi Creek, Rainbow Creek, Eucalyptus West Branch, Eucalyptus Hills East Branch, Pala Mesa Creek, Tributary to Sweetwater River, Steele Canyon Creek, Gopher Canyon Creek, Twin Oaks Valley Creek, Olive Creek, Deer Springs Creek, Stevenson Creek, Coleman Creek, Santa Ysabel Creek, Moosa Creek, Escondido Creek, and Witch Creek.

Peak discharges for streams studied by approximate methods for the February 1995 revision were computed using Manning's equation, USGS Flood-Prone Area Maps (U.S. Department of the Interior, Geological Survey, 1960, 1967, and 1971), and USGS topographic maps (U.S. Department of the Interior, Geological Survey, 1955, 1967, 1968, 1971, 1972, and 1975).

The 1-percent annual chance peak discharges for the 1994 restudy of Pilgrim Creek peak discharges were developed using the USACE HEC-1 hydrologic computer program. The Oceanside Golf Course provides a significant reduction in peak flows due to its function as a detention basin.

The peak discharges for the restudy of Agua Hedionda Creek and Calvera Creek were obtained from the Hydrological Study for Northeastern Carlsbad. This study was performed in accordance with the County of San Diego Hydrology Manual.

The 1-percent annual chance peak discharges for the restudy of Pomerado Creek were determined using the USACE HEC-1 computer program (U.S. Department of the Army, Corps of Engineers, September 1990).

For the restudy of Alvarado Creek (completed in 1996), the base map for the restudy was provided by the City of San Diego, Engineering Development Department (City of San Diego, Engineering and Development Department, 1992). One stream flow gage exists on the study stream. Only 15 years of records were available for this gage. The USACE HEC-1 computer program (U.S. Department of the Army, Corps of Engineers, September 1990) was used to establish peak discharges having recurrence intervals of 10-, 2-, 1-, and 0.2-percent annual chance. The HEC-1 models were developed according to criteria presented in the City of San Diego “Drainage Design Manual” (City of San Diego, April 1984).

Precipitation depths were obtained from the National Oceanic and Atmospheric Administration NOAA Atlas 2, “Precipitation-Frequency Atlas of the Western United States” (U.S. Department of Commerce, 1973). The 24-hour Type B distribution was used in this restudy. Initial and uniform losses of precipitation are accounted for by using the Natural Resources Conservation Service (formerly the SCS) curve method. Lag time was calculated using an equation provided in the City of San Diego “Drainage Design Manual” (City of San Diego, April1984). The Muskingum-Cunge method was used for channel routing.

For the 2000 restudy of Alvarado Creek, FEMA conducted a Limited Map Maintenance Program study along the stream from its mouth upstream to the San Diego/La Mesa City limit, in 1997. The study extends the study along Alvarado Creek from the San Diego/La Mesa City limit upstream to Baltimore Drive. In order for FEMA to conduct the FIS along the lower reach of Alvarado Creek, the hydrology was developed for the entire drainage basin. As a result of that study, this study is using the flow values that were computed and approved by FEMA.

For the restudy of Agua Hedionda Creek in City of Vista, there were no published peak discharges within the study reach that could be used for this study. However, there are published discharges at locations upstream and downstream of the study. The objective of the hydrologic analysis was to determine the 10-, 2-, 1-, and 0.2-percent chance peak discharges at the upstream and downstream limits of the study using the existing data. A drainage area ratio method was adopted to compute the peak flows for the study.

There were two available sources in the FIS that could be used to obtain the existing discharges:

1. Summary of Discharges

2. Floodway Data Tables

The discharges for the FIS Summary of Discharges Table were for the1-percent annual chance flood at some locations, and for the10-, 2-, 1-, and 0.2-percent annual chance floods at other locations. These flows represent the flows from the FIS hydrologic analysis.

The discharges taken from the FIS Floodway Data Tables (FWDTs) were computed by multiplying the mean velocity times the cross-sectional area. Because the FWDT contains information about the 1-percent annual chance flood, only the 1-percent annual chance discharges could be determined. These flows represent the flows used in the previous hydraulic model(s).

The drainage area ratio method was adopted to compute the peak flows for the study using the following equations:

$$Q_1 = Q_2 \, (A_1/A_2)^{a}$$

Where,

Q_1= Discharge at an Upstream Location
Q_2= Discharge at a Downstream Location
A_1= Drainage Area at an Upstream Location
A_2= Drainage Area at an Downstream Location
a = Constant

The constant “a” was determined using known discharges at different upstream and downstream locations within the project area along Agua Hedionda Creek and Buena Creek. An average value of “a” was selected. Based on the computed value of “a”, the peak discharges for the study were determined. The computed average of “a” was found to be 0.70.

The 10-, 2-, 1-, and 0.2-percent annual chance peak discharges at the downstream limit of the study were computed using the most upstream location, where the n-year peak discharges were available.

The computed discharges recommended for use in the study area are in line with those used in the FIS. The computed 1-percent annual chance was in better agreement with the 1-percent annual chance USGS regression equation flow than the 10-, and 2-percent annual chance discharges. Because there was no published regression equation for calculating the 0.2-percent annual chance discharges, no comparison of the 0.2-percent annual chance discharges was made.

Because the study reach is relatively short (1.25 miles), and because there are no major tributaries within the study area, the computed discharges were used in the hydraulic model from the downstream end to the upstream end.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 8, “Summary of Peak Discharges.”

TABLE 8: SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (sq. miles)**	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
Adobe Creek					
2,200 Feet Upstream of Peet Lane	0.67	375	485	560	710
Agua Hedionda Creek					
At Confluence with Buena Creek	6.3	1,600	4,800	7,000	15,500
2,200 Feet Upstream of Rancho Carlsbad Drive	16.5	--	--	7,810	--
Upstream of Calavera Creek	17.3	--	--	8,080	--
At El Camino Real	23.8	--	--	9,850	--
Alvarado Creek					
At Lake Shore Drive	4.6	1,200	2,000	2,300	3,000
At Interstate 8, Near Trailer Park	5.3	1,300	2,200	2,500	3,200
At Interstate 8, Near Murray Boulevard	5.7	1,400	2,400	2,700	3,500
Upstream of Murray Creek	6.3	1,600	2,600	3,000	3,800
Downstream of Murray Creek	10.1	1,700	2,900	3,300	4,200
At Downstream Side of College Avenue	11.4	2,100	3,400	3,900	5,000
Upstream of Tributary Channel	12.1	2,300	3,700	4,300	5,400
Downstream of Tributary Channel	13.4	2,600	4,300	4,800	6,100

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (sq. miles)**	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
At San Diego River	14.0	2,700	4,500	5,100	6,500
Beaver Hollow Creek					
Approximately 1,200 Feet Downstream of Beaver Hollow Road	5.0	--	--	4,000	--
Beeler Creek					
At U.S. Geological Survey (USGS) Gage on Downstream Side of Pomerado Road	5.5	700	2,400	3,600	9,200
Borrego Palm Canyon					
At Apex of Alluvial Fan	23.3	3,100	7,700	10,650	14,800
Box Canyon					
At Apex of Alluvial Fan	5.9	850	2,600	3,850	4,950
Broadway Creek					
At Mouth	3.8	500	1,200	1,600	4,200
Buena Creek					
At Mouth	6.3	1,880	3,520	4,100	5,420
At Buena Creek Road	1.5	--	--	1,980	--

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Buena Vista Creek					
Upstream of Interstate Highway 5	20.8	2,000	5,600	8,500	19,000
At Sunset Drive	15.9	1,700	5,100	8,000	18,000
Just Downstream of Melrose Drive	9.5	3,300	5,480	6,540	12,000
At State Highway 78	9.3	3,170	5,320	6,340	11,000
Just Upstream of Confluence with Buena Vista Creek Tributary 3	7.5	2,060	3,520	4,400	9,500
Approximately 400 Feet Downstream of South Santa Fe Avenue	5.4	1,470	2,340	2,650	5,000
At South Santa Fe Avenue	5.3	1,435	2,280	2,580	5,000
Approximately 500 Feet Upstream of Escondido Avenue	4.4	750	1,880	2,270	4,000
At Intersection of Vista Way and Arcadia Avenue	0.2	40	100	130	170
Buena Vista Creek Tributary 1					
At Confluence with Buena Vista Creek	2.6	460	1,180	1,510	2,020
At Intersection of Monte Vista Drive and Santa Fe Avenue	1.7	320	800	1,010	1,350
At Intersection of Monte Vista and Valley Drives	1.0	210	510	630	840

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Buena Vista Creek Tributary 2					
At Confluence with Buena Vista Creek	0.8	110	410	530	700
At Intersection of Eucalyptus Avenue and Tiger Tail Road	0.5	110	280	360	480
Buena Vista Creek Tributary 3					
At Confluence with Buena Vista Creek	4.7	--	--	1,880	3,500
Buena Vista Creek Tributary 4					
At Confluence with Buena Vista Creek	2.5	570	1,210	1,450	1,860
Calavera Creek					
Upstream of Rancho Carlsbad Mobile Home Park	4.5	--	--	500	--
Confluence with Agua Hedionda Creek	5.8	--	--	910	--
Carmel Valley Creek					
Above Confluence with Soledad Canyon	15.7	2,100	6,500	9,800	21,300
Below Confluence with Shaw Valley Creek	11.0	1,400	4,200	6,300	13,700
Carroll Canyon Creek					

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Atchison, Topeka & Santa Fe Railway	17.8	1,500	4,500	6,700	18,700
At Interstate Highway 805	15.0	1,300	3,800	5,600	15,700
At Carroll Canyon Road	12.0	1,000	3,000	4,500	12,500
Coleman Creek					
Approximately 1,800 Feet Downstream of Highway 78	8.1	--	--	8,750	--
Coyote Creek					
At Apex of Alluvial Fan	132.0	5,200	16,000	24,000	35,200
Culp-Tubb Canyon					
At Apex of Alluvial Fan	13.0	2,400	6,000	8,500	12,500
Dear Springs Creek					
At Mouth	1.8	--	--	1,550	--
Descanso Creek					
At Mouth	5.6	1,300	3,800	6,000	10,400
Dry Canyon					

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Apex of Alluvial Fan	1.9	450	1,150	1,700	2,650
Encanto Branch					
Above Confluence with South Las Chollas Creek	6.0	1,200	2,700	3,500	6,600
Above Confluence with Radio Drive Tributary	4.8	1,100	2,600	3,400	6,500
At 64th Street	4.2	950	2,300	3,000	6,100
Above Confluence with Jamacha Branch	2.4	640	1,400	1,700	3,200
Escondido Creek					
At Interstate Highway 5	77.7	3,400	15,500	22,000	41,000
Upstream of Lake Val Sereno	68.0	3,200	14,500	21,000	38,400
Upstream of Elfin Forest Lake	55.7	2,800	13,000	19,000	35,000
At Harmony Grove Road	48.3	2,600	12,000	18,000	32,000
Approximately 11,200 feet Upstream of Wohlford Dam	2.2	--	--	2,700	--
Eucalyptus Hills East Branch					
At Riverside Drive	1.5	--	--	860	--
Eucalyptus Hills West Branch					

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second)			
		10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Riverside Drive	1.9	--	--	970	--
Fire Canyon					
At Apex of Alluvial Fan	0.8	200	550	900	1,500
Florida Drive Branch					
Above Confluence with Switzer Creek	2.5	490	1,120	1,350	2,340
Forester Creek					
At Terra Lane	2.3	--	--	---	--
At Prospect Avenue	22.7	6,000	11,000	12,450	28,000
Garrison Creek					
At Confluence with Loma Alta Creek	2.24	230	780	1,130	1,940
6,500 Feet Upstream of El Camino Real	0.97	110	340	570	970
Gopher Canyon Creek					
At Mouth	11.0	--	--	7,690	--
Gonzales Canyon Creek					

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Old El Camino Real	2.4	--	--	1,606	--
Green Valley Creek					
At Corporate Limits with City of San Diego	3.2	950	2,050	2,700	4,700
At Orchard Bend Road	1.5	450	925	1,200	2,000
Green Valley Creek Tributary					
At Confluence with Green Valley Creek	0.3	80	200	300	600
Harbison Canyon Creek					
At Noakes Street Crossing	--	500	--	2,100	--
At Warfield Way Crossing	--	750	--	3,000	--
At Collier Way Crossing	--	775	--	3,200	--
At Dehesa Road Crossing	--	1,050	--	4,700	--
Hatfield Creek					
At Mouth	20.8	1,700	7,900	13,700	35,600
Hellhole Canyon					
At Apex of Alluvial Fan	4.8	1,900	4,250	6,450	9,200

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (sq. miles)**	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
Henderson Canyon					
At Apex of Alluvial Fan	4.8	750	2,100	3,500	5,650
Home Avenue Branch					
At Confluence with Las Chollas Creek	2.1	430	950	1,200	2,200
0.8 Mile Above Fairmont Avenue	1.3	260	580	730	1,340
At Euclid Avenue	1.1	220	500	630	1,200
At Auburn Drive	0.8	160	360	450	830
Jesmond Dene Tributary					
Approximately 200 feet upstream of North Broadway	2.32	--	--	1,746	--
Keys Canyon Creek					
Just upstream of Keys Canyon Creek Tributary 2	14.62	--	--	13,044	--
Just upstream of Keys Canyon Creek Tributary 1	14.98	--	--	13,120	--
Just downstream of Keys Canyon Creek Tributary 1	31.58	--	--	22,911	--
Keys Canyon Creek Tributary 1					

— Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (sq. miles)**	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
Just upstream of Keys Canyon Creek	14.98	--	--	13,120	--
Keys Canyon Creek Tributary 2					
Just upstream of Keys Canyon Creek	14.62	--	--	13,044	--
Kit Carson Park Creek					
At Mouth	6.8	1,000	2,900	4,400	9,600
At Bear Valley Parkway	3.5	600	1,900	2,800	6,100
Las Chollas Creek					
At Main Street	26.4	4,200	8,000	10,000	21,000
Above Confluence with South Las Chollas Creek	15.3	3,000	6,000	7,900	15,000
At Market Street	12.7	2,700	5,400	7,100	13,500
Above Confluence with Wabash Branch	8.7	1,900	3,800	4,700	7,700
Above Confluence with Home Avenue Branch	6.6	1,500	2,800	3,500	5,500
Above Confluence with Chollas Reservoir Branch	4.9	1,400	2,400	3,000	4,300
Las Posas Creek					
Upstream of Confluence with San Marcos Creek	--	1,100	1,800	2,450	3,150

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Upstream of Las Posas Culvert Entrance	--	750	1,200	1,850	2,350
Las Puleta Creek					
At San Diego and Arizona Eastern Railroad	2.8	550	1,200	1,400	2,500
Downstream of Confluence with Logan Avenue Branch	1.5	300	730	870	1,690
At 47th Street	0.8	160	390	470	910
0.6 Mile Upstream of Cervantes Avenue	0.1	20	50	60	120
Lawson Valley Creek					
Approximately 7,200 Feet Upstream of Mouth	10.2	--	--	9,000	--
Loma Alta Creek					
At Mouth	9.1	800	2,500	3,800	8,200
Downstream of El Camino Real	4.7	450	1,500	2,200	4,800
Upstream of El Camino Real	2.9	350	1,100	1,700	3,700
Los Penasquitos Creek					
Above Confluence with Soledad Canyon	58.3	3,700	11,300	16,800	37,600

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At U.S. Highway 395	42.7	3,100	10,000	15,400	35,800
Upstream of confluence with Chicarita Creek	33.6	2,500	8,700	14,000	34,000
Lusardi Creek					
At Mouth	8.6	--	--	5,680	--
McGonigle Canyon Creek					
Downstream of Camino Ruiz Road	2.04	--	--	853	--
Upstream of Camino Ruiz Road	1.35	--	--	571	--
Approximately 1,400 feet upstream of Camino Ruiz Road	1.22	--	--	537	--
McGonigle Canyon Creek Tributary A					
Approximately 200 feet upstream of Confluence with Mcgonigle Canyon Creek	0.08	--	--	57	--
Mexican Canyon Creek					
At Confluence with Sweetwater River	4.7	360	1,480	2,250	3,300

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At U.S. Highway 94, 9,600 Feet Upstream of Confluence	2.0	160	700	1,060	1,470
Moosa Canyon Creek					
Near Junction of Moosa Road and U.S. Highway 395	34.7	2,600[1]	9,000[1]	13,000[1]	29,000[1]
At U.S. Highway 395, Near River at Elevation 400 Feet	29.2	2,200[1]	7,500	11,550[1]	26,000[1]
Upstream of Confluence with South Fork Moosa Canyon Creek	21.4	1,400[1]	5,100[1]	7,800[1]	17,000[1]
At Old Castle Ranch	15.0	800[1]	3,300[1]	5,100[1]	11,000[1]
At Unnamed Road	3.0	--	--	3,120	--
Murphy Canyon					
Upstream of Friars Road	12.1	1,500	2,700	3,500	5,500
Downstream of Aero Drive	10.1	1,100	2,400	3,000	3,800[2]
Upstream at Aero Drive	10.1	1,100	2,400	3,000	5,000
Downstream of Confluence with Shepard Canyon	9.2	850	2,000	2,400	4,200
Upstream of Confluence with Shepard Canyon	6.2	550	1,400	1,700	3,300

-- Data Not Available

[1] Flows Partially Controlled by Turner Dam

TABLE 8: SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (sq. miles)**	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
Downstream of Balboa Boulevard	5.9	550	1,400	1,700	3,300
Upstream of Balboa Boulevard	5.9	550	1,400	1,700	3,300
Downstream of Confluence with Unnamed Tributary	5.8	550	1,400	1,700	3,300
Downstream of Clairmont Mesa Boulevard	3.4	350	800[2]	1,000[2]	1,850[2]
Upstream of Clairmont Mesa Boulevard	3.4	350	950	1,400	2,800
Murray Canyon Creek					
At Mouth	3.93	1,200	2,400	3,100	4,800
Upstream of Unnamed Tributary	2.74	1,000	1,700	2,100	3,300
Downstream of Interstate Highway 805	1.76	800	1,200[3]	1,400[3]	1,800[3]
Upstream of Interstate Highway 805	1.76	800	1,600	2,100	3,400
Nestor Creek					
At Palm Avenue	2.75	--	--	1,093	--

-- Data Not Available
[2] Decreases Due to Ponding Upstream
[3] Decrease Due to Overbank Losses Upstream
[4] Decrease Due to Construction of "Lot 6 Detention Basin" Upstream of Railroad

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At 19th Street	--	--	--	864[4]	--
At Elm Avenue	2.45	--	--	796[4]	--
At Coronado Avenue	2.33	--	--	698[4]	--
At Hollister Street	1.99	--	--	496[4]	--
At 25th Street/Interstate 5	1.71	--	--	456[4]	--
At San Diego and Arizona Eastern Railroad	1.40	555	860	1,015	2,295
North Avenue Tributary					
Approximately 1,730 feet upstream of North Broadway	0.5	--	--	440	--
North Branch Poway Creek					
At Sycamore Canyon Road	4.5	650	2,000	3,000	7,200
North Tributary to Santa Maria					
At Mouth	1.6	100	600	1,100	2,900
Olive Creek					
At Mouth	1.0	--	--	1,370	--

-- Data Not Available

[4] Decrease Due to Construction of "Lot 6 Detention Basin" Upstream of Railroad

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Otay River					
At Otay Valley Road	122.7	1,200	12,000	22,000	50,000
Pala Mesa Creek					
Approximately 265 Feet Upstream of Interstate Highway 15	2.1	--	--	1,700	--
Paradise Creek – Valley Road Branch					
At Confluence with Paradise Creek	0.68	--	--	468	--
Pauma Creek					
At Apex of Alluvial Fan	14.7	1,550	6,270	10,480	30,460
Pilgrim Creek					
Upstream End of Oceanside Golf Course	14.0	--	--	5,775	--
Downstream End of Oceanside Golf Course	14.0	--	--	1,244	--
Just Upstream of the Confluence with Windmill Creek	15.8	--	--	1,888	--
At Mouth	19.0	--	--	1,925	--

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Poggi Canyon Creek					
At City of Chula Vista Corporate Limit	3.74	180	830	1,280	2,470
At Confluence with Otay River	4.63	220	930	1,400	2,630
Pomerado Creek					
At confluence with Poway Creek	4.3	--	--	2,100	--
At Tassel Road	3.9	--	--	1,990	--
At Vaughn Road	3.3	--	--	1,750	--
At Holland Road	2.9	--	--	1,570	--
Poway Creek					
USGS Gage at Cobblestone Creek Road	31.2	2,500	8,700	14,000	34,000
USGS Gage 1,000 feet Upstream of Standish Drive	7.9	1,100	3,700	5,600	14,000
Rainbow Creek					
At Interstate Highway 15	7.1	--	--	5,210	--

-- Data Not Available

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Rattlesnake Creek					
USGS Gage 400 feet Upstream of Confluence with Poway Creek	8.1	750	2,500	3,900	9,700
Reidy Creek					
Above Confluence with Escondido Creek	15.1	1,300	5,000	7,700	14,000
At Rincon Avenue	10.5	1,100	5,000	7,100	14,000
Upstream of Jesmond Dene Avenue	4.5	600	2,600	4,000	7,300
Rice Canyon Creek					
4,780 Feet Upstream of H Street	2.64	140	780	1,200	1,710
At H Street	3.25	170	890	1,350	1,940
At Confluence with Sweetwater River	3.60	180	920	1,400	2,030
Rincon Avenue Tributary					
Approximately 1,400 feet upstream of Confluence with Reidy Creek	2.33	--	--	1,830	--
Rose Canyon Creek					
At Mouth	37.0	2,700	8,100	12,000	28,000

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Downstream of Confluence with San Clemente Creek	32.1	2,500	7,600	11,000	26,500
Upstream of Confluence with San Clemente Creek	13.7	1,300	4,000	6,200	13,900
Upstream of State Highway 52	13.2	1,300	3,800	6,100	13,400
Downstream of Genesse Avenue	9.7	1,100	3,200	5,000	11,200
Downstream of Interstate Highway 805	6.9	900	2,700	4,100	9,400
Samagutuma Creek					
At Mouth	6.4	900	2,600	4,000	7,000
San Clemente Canyon Creek					
Upstream of Confluence with Rose Canyon Creek	18.4	1,400	4,200	6,900	16,000
Upstream of Genesee Avenue	15.3	1,200	3,600	5,600	12,000
Upstream of Interstate Highway 805	12.5	1,000	3,100	4,900	11,000
San Diego River					
At Confluence with Murphy Canyon Creek	420.0	3,100	17,000	36,000	112,000
Just Downstream of Confluence of San Vicente Creek	290.0	2,500	--	31,000	--

TABLE 8: SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (sq. miles)**	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
San Dieguito River					
Upstream of Camino Del Mar Bridge	--	5,700	31,400	41,800	90,000
Upstream of Atchison, Topeka & Santa Fe Railway Bridge	--	5,700	31,400	41,800	90,000
Upstream of Jimmy Durante Bridge	--	5,800	32,100	42,400	90,000
Upstream of U.S. Interstate Highway 5 Bridge	--	5,900	32,500	42,800	90,00
San Elijo Creek					
0.1 Mile Upstream of El Camino Road	5.4	500	1,600	2,100	5,500
San Luis Rey River					
At Mouth	560.0	6,600	31,000	51,000	120,000
Downstream of Confluence with Moosa Canyon	355.6	6,200	30,000	48,000	110,000
Downstream of Confluence with Keys Canyon	252.3	5,000	25,000	41,000	98,000
Upstream of Confluence with Keys Canyon	180.4	4,000[5]	20,000	33,000	85,000
Downstream of Palma	167.3	4,000[5]	18,000	30,000	78,000
Downstream of Confluence with Puma Creek	126.7	4,000[5]	16,800	28,000	72,800
Upstream of Confluence with Puma Creek	71.5	5,000	15,000	24,500	64,000

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
San Marcos Creek					
Upstream of the San Marcos Dam (Lake San Marcos)	28.1	--	--	15,700	--
Upstream of Discovery Street	--	7,400	13,300	14,700	19,350
Upstream of Confluence with Las Posas Creek	--	6,450	11,650	13,150	16,950
Upstream of Highway 78	--	6,200	11,000	12,450	16,000
Upstream of Confluence with Twin Oaks Valley Creek	--	2,600	4,550	5,150	6,600
Approximately 1,000 Feet Upstream of Confluence with Twin Oaks Valley Creek	--	2,200	3,900	4,400	5,600
San Vicente Creek					
At Mouth	83.0	1,400	10,500	16,000	34,000
Santa Maria Creek (Santa Maria Valley Area)					
Below Confluence with North Tributary	33.1	1,900	9,200	15,600	42,000
Santa Maria Creek (San Pasqual Valley Area)					
At Confluence with Santa Ysabel Creek	60.0	3,200	14,700	19,000	30,000

-- Data Not Available

[5] Discharge Decreases With Increasing Area Due to Breakouts From the Low Flow Channel

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Santa Ysabel Creek					
Lake Hodges at Hodges Dam	290	10,000	48,000	62,000	95,000
Below Confluence with Santa Maria Creek	221	9,000	42,500	55,000	85,000
Above Confluence with Santa Maria Creek	160	6,100	29,000	37,000	60,000
Approximately 15,500 Feet Upstream of Confluence With Witch Creek	23.8	--	--	20,750	--
Shallow Flooding Area – South					
Citrus Wash at Escondido Creek, 500 Feet Downstream of the Rose Street Bridge	2.4	600	1,440	1,920	2,550
Citrus Wash at Reed Road, 600 Feet West of Falconer Road	0.3	100	230	290	380
South Midway Wash at Midway Drive, 400 Feet Northwest of Grand Avenue	2.0	490	1,180	1,570	2,070
Shallow Flooding Area - North					
Midway Wash at Midway Drive Crossing of Escondido Creek	2.0	350	1,060	1,520	2,020
Lincoln Avenue and Midway Drive	1.7	290	920	1,310	1,750

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (sq. miles)**	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
Maywood Wash at Intersection of East Lincoln Avenue and Nightingale Place	1.3	230	720	1,020	1,350
Shallow Flooding Area - West					
Country Club Creek at El Norte Parkway, 1,100 Feet Northwest of Bennett Avenue	2.1	540	1,330	1,700	2,220
Country Club Creek at Nutmeg Street, 1,200 Feet North of Golden Circle Drive	0.3	70	200	260	350
Unnamed Tributary at Intersection of Golden Circle Drive and Country Club Lane	0.9	240	590	770	990
Slaughterhouse Creek					
Approximately 1,800 Feet Upstream of Mouth	2.9	--	--	2,450	--
Soledad Canyon					
At Mouth	95.5	5,000	15,400	23,000	51,500
Downstream of Confluence with Los Penasquitos Creek	76.1	4,200	13,100	19,000	43,700
South Branch Poway Creek					
Approximately 1,150 Feet Upstream of Sycamore Canyon Road	1.8	400	1,200	1,800	4,300
South Fork Moosa Canyon Creek					

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (sq. miles)**	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
0.3 Mile Above Mouth	7.1	1,200[1]	3,400	5,200[1]	10,400
At Oak Shadows Drive	4.3	700	2,100	3,200	6,500
South Las Chollas Creek					
Above Confluence with Las Chollas Creek	10.9	2,000	3,900	5,300	9,500
Above Confluence with Encanto Branch	3.3	730	1,400	1,900	3,400
At Kelton Road	2.6	580	1,100	1,500	2,700
South Tributary to Santa Maria Creek					
At Mouth	9.3	700	3,400	5,800	15,000
Spring Valley Creek					
Below Confluence with Casa de Oro Creek	7.1	1,300	2,600	3,600	9,300
Steele Canyon Creek					
At Mouth	2.7	--	--	2,980	--
Stevenson Creek					

[1] Flow Partially Controlled by Turner Dam
-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Mouth	1.2	--	--	900	--
Sunrise Overflow					
At Hollister Street	--[7]	50	435	700	1,800
At Iris Avenue	--[7]	0	300	550	3,000
Sweetwater River (Above Reservoir)					
At Broadway	219.0	1,200	21,000	35,000	60,000
At Intersection of Sweetwater and Bonia Roads	197.0	1,200	21,000	35,000	60,000
Below Confluence with Spring Valley Creek	194.0	1,200	21,000	35,000	60,000
Above Sweetwater Reservoir	174.0	5,600	21,500	29,500	53,600
Below Confluence with Harbison Creek	138.0	5,500	21,000	29,000	53,000
Below Confluence, North Fork	131.0	5,300	20,500	28,000	50,000
Sweetwater River (At National City)					
At Broadway	219.0	1,200	21,000	35,000	60,000
Sweetwater River (Near Descanso)					
At Japatul Valley Road Bridge	41.0	3,800	14,800	20,300	36,800

--[7] This Area is Subject to Overflow Flooding; and therefore, does not have a Defined Contributing Drainage

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Above Confluence with Descanso Creek	25.2	2,900	11,000	15,100	27,200
Switzer Creek					
At Harbor Drive	4.3	830	2,200	2,600	5,000
Upstream of Russ Boulevard	3.5	675	1,540	1,870	3,220
Above Confluence with Florida Drive Branch	1.0	185	420	510	880
Tecolote Creek					
At Interstate.Highway 5	9.29	2,100	3,800	4,900	9,300
Downstream of Confluence with Unnamed Tributary	7.28	2,000	3,700	4,700	8,900
Upstream of Confluence with Unnamed Tributary	4.04	1,100	1,900	2,400	4,500
Downstream of Balboa Avenue	2.54	750	1,300	1,600[8]	2,600[8]
Upstream of Balboa Avenue	2.54	750	1,300	1,700	3,100
Downstream of Genesee Avenue	1.64	640	1,100	1,400[9]	2,100[9]
Upstream of Genesee Avenue	1.64	640	1,100	1,500	3,000

[8] Decrease Due to Culvert Restriction at Balboa Avenue
[9] Decrease Due to Culvert Restriction at Genesee Avenue

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Telegraph Canyon Creek					
At Interstate Highway 5	7.3	900	2,100	2,800	5,500
At Hilltop Drive	5.5	600	1,600	2,200	4,700
Upstream of La Media Road	2.35	--	--	1,197	--
Downstream of La Media Road	2.35	--	--	962 [10]	--
At approximately 2,000 feet upstream of St. Claire Drive	1.04	290	583	854	1,100
Telegraph Canyon Creek Overflow	--	0	100	800	3,500
Tijuana River					
At Mouth	1,700.0	17,000	50,000	75,000	150,000
Tributary of the South Tributary to Santa Maria Creek					
At Mouth	5.8	400	2,100	3,600	9,400
Tributary to Sweetwater River					
At Arroyo Road	2.8	--	--	2,070	--

-- Data Not Available
[10] Decrease Due to Detention Upstream of Culvert
-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Tributary to Forester Creek					
At Madison Avenue	1.8	--	--	1,002	--
Twin Oaks Valley Creek					
Upstream of Confluence with San Marcos Creek	--	3,450	6,250	7,100	9,100
Approximately 1,700 feet Upstream of Windy Way	--	3,250	5,900	6,700	8,700
At Olive Drive	6.7	3,200	5,250	6,500	8,400
Upstream Buena Creek Road	--	2,600	4,600	5,200	6,700
Unnamed Canyon					
At Apex of Alluvial Fan	4.6	650	1,900	2,900	5,100
Unnamed Tributary to San Dieguito River					
At Four Gee Road	1.82	--	--	1,217	--
Vado Canyon					
At Apex of Alluvial Fan	3.5	400	1,500	2,200	4,100

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
Wabash Branch					
Above Confluence with Las Chollas Creek	4.1	700	1,380	1,600	2,700
Above Confluence with Wabash Tributary	3.5	570	1,190	1,380	2,330
Witch Creek					
Approximately 7,700 Feet Upstream of Mouth	3.3	--	--	3,540	--

-- Data Not Available